The Advanced® Osmometer

Model 3D3

User's Guide

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Notes:

Safe Use

To reduce the risk of bodily injury, electric shock, fire, and damage to your instrument, please read and observe the precautions in this User's Guide.

- If the product is used in a manner not in accordance with the equipment design, operating instructions or manufacturer's recommendations, the operation of the product may be impaired to the extent that a safety hazard is created.
- Do not attempt to perform electrical work if you are not fully qualified. This manual is not a substitute for electrical training.

Symbol conventions

The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying this product.

The lightning flash with arrowhead symbol within an equilateral triangle is intended to alert the user to the presence of uninsulated dangerous voltage within the product's enclosure that may be of sufficient magnitude to constitute risk of electric shock to persons.

The static symbol within an equilateral triangle is intended to alert the user to the presence of internal components that could be damaged by static electricity.

This static symbol is intended to alert the user to the presence of a specific component that could be damaged by static electricity.

This symbol indicates the presence of alternating current (AC).

This symbol indicates the presence of a fuse.

This symbol indicates the presence of protective earth ground.

General cautions

- This product should be operated only with the type of power source indicated on the product's electrical ratings label. Refer to the installation instructions included with the product.
- If the power cord provided is replaced for any reason or if an alternate cord is used, the cord must be approved for use in the local country. The power cord must be approved for the product's listed operating voltage and be rated at least 20% greater than the ampere ratings marked on the product's electrical ratings label. The cord end that connects to the product must have an IEC 60320 connector.
- Plug the product into an approved grounded electrical outlet.
- Do not disable the power cord's grounding plug.
- If an extension cord or power strip is used, make sure that the cord or strip is rated for the product, and that the total ampere ratings of all products plugged into the extension cord or strip do not exceed 80% of the cord's or strip's rating limit.
- Route power cords so that they will not be walked on, tripped on, or pinched by items placed upon or against them. Pay particular attention to the plug, electrical outlet, and the point where the cord exits the product.
- Do not pull on cords and cables. When unplugging cords or cables, grasp the corresponding connector.

- Do not install or use this product in any area subject to extreme short-term temperature variations, or locations that exceed the specified operating environment temperatures.
- Never use this product in a wet area.
- To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.
- Do not install or use the product on an unstable, non-level work surface.
- Do not operate this product with the covers removed or unsecured.

Notes:

Parts & Accessories

To order parts and accessories, contact the Advanced Instruments Customer Service Department by using one of the following numbers.

- 800-225-4034 (toll-free within the USA and Canada)
- +US 781-320-9000 (elsewhere)
- 781-320-3669 (fax)

PART DESCRIPTION	PART NO.
1-Amp Time Delay (T) Fuse for 200-250V	7011
2-Amp Time Delay (T) Fuse for 100-130V	7022
Clapper	3C2241
Disposable Air Filters	3D2340
Disposable Sample Tubes, 0.2 or 0.25 mL	3LA825
Thermal Printer with Interface Cable, Operation Manual, Thermal Paper Roll, and Printer Power Supply (100-120 VAC)	3D3555_NA
Thermal Printer with Interface Cable, Operation Manual, Thermal Paper Roll, and Printer Power Supply (230 VAC)	3D3555_EU
Heat Transfer Fluid	3DA811
Heat Transfer Fluid Filter	4S0710
Mandrel	3LH500
Operator/Supervisor Keys	3D3185
Power Cord (specify voltage and country)	———
Printer Paper (5 rolls)	3D3835

PART DESCRIPTION	PART NO.
Probe/Stir Wire Alignment Tool	3LA700
Replacement Sample Probe with Mandrel and three 10-mL ampules of Probe Bin Setting Fluid (Stainless Steel)	3D3700
Sample Tube Rack	3LA846
Serial Port Interface Computer Cable Computer Connector, 3 Meters	3M3053
Serial Port Interface Computer Cable Computer Connector, 6 Meters	3M3056
Serial Port Interface Computer Cable Computer Connector, 9 Meters	3M3059
Service Manual, 3D3/4D3	4D35SM
Stir/Freeze Coil	3D2404
Stir/Freeze Wires	3LH243
User's Guide	3D35
Yoke	3LH230

Calibrators & Standards

To order calibrators and standards, contact the Advanced Instruments Customer Service Department by using one of the following numbers.

- 800-225-4034 (toll-free within the USA and Canada)
- +US 781-320-9000 (elsewhere)
- 781-320-3669 (fax)

DESCRIPTION	PART NO.
Clinitrol™ mOsm/kg Reference Solution (10 5mL ampules)	3LA029
Five-Level Osmolality Linearity Set: 100, 500, 900, 1500 and 2000 mOsm (10 5mL ampules, 2 of each value)	3LA028
Protinol® 3-Level Protein Control Kit (9 3mL bottles, 3 of each level)	3MA028
Renol™ Urine Osmolality Controls (2 levels)	3LA085
100 mOsm/kg Calibration Standard (110mL bottle)	3LA010
100 mOsm/kg Calibration Standard (10 5mL ampules)	3LA011
500 mOsm/kg Calibration Standard (110mL bottle)	3LA050
500 mOsm/kg Calibration Standard (10 5mL ampules)	3LA051
900 mOsm/kg Calibration Standard (110mL bottle)	3LA090
900 mOsm/kg Calibration Standard (10 5mL ampules)	3LA091
1500 mOsm/kg Calibration Standard (110mL bottle)	3LA150
1500 mOsm/kg Calibration Standard (10 5mL ampules)	3LA151
2000 mOsm/kg Calibration Standard (10 5mL ampules)	3LA201
3000 mOsm/kg Calibration Standard (10 5mL ampules)	3LA301

Notes:

Foreword

Principles of Freezing-Point Osmometry

When a solute is dissolved in a pure solvent, the following changes in the solution's properties occur:

- the freezing point is depressed,
- boiling point is raised,
- osmotic pressure is increased, and
- vapor pressure is lowered.

These are the so-called "colligative" or concentrative properties of the solution which, within reasonable limits, change in direct proportion to the solute concentration; in other words, the number of particles in solution.

Of the colligative properties, measurement of the freezing point allows the concentration of an aqueous solution to be easily determined with great precision.

The freezing point of pure H_2O is precisely +0.010°C. One mole of a non-dissociating solute such as glucose (where the solute does not dissociate into ionic species, but remains intact), when dissolved in 1 kilogram (kg) of water will depress the freezing point by 1.858°C. This change is known as the freezing point depression constant for water. The freezing point depression also depends upon the degree of dissociation of the

solute. If the solute is ionic, the freezing point is depressed by 1.858°C for each ionic species. For example, if one mole of sodium chloride were to completely dissociate into two ionic species (Na+ and Cl-) in 1 kg of water, the freezing point would be depressed by 3.716°C. However, dissociation is never complete. Interference between solute molecules reduces dissociation by a factor called the osmotic coefficient.

In a simple solution such as glucose or sodium chloride in water, the freezing point can be measured and the unit concentration easily determined from an equation or a reference table. However, the equation is unique for each solute. In a more complex solution, all ionized and non-dissociated species contribute to the freezing-point depression and the concentration of each solute cannot be easily determined.

Each of the colligative properties has a similar problem, and though each of the colligative properties changes in direct proportion to the solute concentration, each requires a different mode & unit of measurement. Osmolality is a common unit of concentration measurement that can be used to relate all the colligative properties to each other, and to other concentration units. Because of its universality, most osmometry applications regularly use osmolality, expressed as "mOsm/kg H_2O", as the common unit of concentration rather than applying further conversion factors.

Instrumentation

Advanced Osmometers are devices for the determination of the concentration of solutions by means of freezing-point measurement.

Advanced Osmometers utilize high-precision thermometers to sense the sample temperature, to control the degree of supercooling and freeze induction, and to measure the freezing point of the sample. They can routinely determine differences of ±1 mOsm/kg H_2O.

Freezing-Point Thermodynamics

The quickest and most precise way to measure the freezing point of a solution is to supercool it several degrees below its freezing point. It is unstable in this state, and a mechanical agitation induces crystallization. The heat of fusion suddenly liberated causes the sample temperature to rise toward a plateau temperature, where a liquid/solid equilibrium occurs. The equilibrium temperature is, by definition, the freezing point of the solution. Managing the plateau temperature for precise measurement is the basis for several patents issued to Augustus Fiske.

The time over which liquid/solid equilibrium develops and is maintained, is a function of the speed with which the heat-of-fusion is liberated vs. the speed it is transferred away, or absorbed, by the surrounding environment. This ratio can be slowed and the equilibrium time stretched, to give a distinct plateau height measurable to 0.001°C.

Sensitive thermistor probes monitor the sample temperature and control the thermoelectric cooling element. Microprocessor control and automated operation minimize imprecision due to operator technique.

Figure 1 illustrates the temperature of a sample as it progresses through the freezing cycle and shows the action of the instrument at each stage of the cycle.

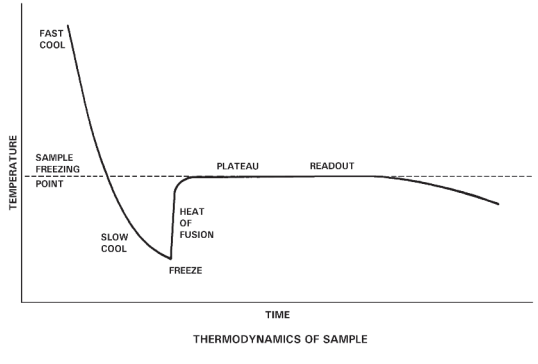

Figure 1: Standard Freezing Curve

Definitions

Solution: A homogeneous mixture of solute and solvent in which the solvent is usually the major component, and the solute is the minor component.

Concentration: The ratio of solute to a given amount of solvent (molal), or ratio of solute to solution (molar).

The amount of solute is usually expressed in terms of moles (i.e., gram molecular weights). One mole = 6.028×10^{23} molecules (Avogadro's number). One mole of glucose (180.2 g) and one mole of sodium chloride (58.4 g) each contain Avogadro's number of molecules.

Common units of concentration are:

- **Molality**: Moles of solute per kilogram of pure solvent.

- **Osmolality**: Osmols of solute particles per kilogram of pure solvent. As noted above, most ionic solutes do not completely dissociate. Osmolality is a unit of concentration that takes into account the dissociative effect. Osmolality is usually expressed in mOsm/kg H_2O. One milliosmol (mOsm) is 10^{-3} osmols. Osmolality is defined as:

$$Osmolality = \phi nC = \frac{osmol}{kg\ H_2O}$$

  where:
  ϕ = osmotic coefficient, which accounts for the degree of molecular dissociation.
  n = number of particles into which a molecule can dissociate.
  C = molal concentration of the solution.

- **Molarity**: Moles of solute per liter of solution.

- **Osmolarity**: Osmols of solute particles per liter of solution.

Although molarity and osmolarity may be common units of measurement in other branches of chemistry, they are not used in osmometry because the ratio of solute to solution is not linear. Molality and osmolality are linear, independent of the effect of temperature and volume displaced by solute. A calculated conversion between units of molality and molarity is complex and generally unnecessary when the terms are properly understood.

Freezing Point/Melting Point: The temperature at which the liquid and solid phases of a substance will remain together in equilibrium.

Freezing-Point Depression: When a solute is added to a solvent, the freezing point of the solvent is lowered. In aqueous solutions, one mOsm of solute per kilogram of water depresses the freezing point by 1.858 millidegrees Celsius (m°C).

Supercooling: The tendency of a substance to remain in the liquid state when cooled below its freezing point.

Crystallization Temperature: Aqueous solutions can be induced to freeze (i.e., crystallize) most reliably when supercooled. When supercooled, agitating the solution (freeze pulse) induces crystal formation. The crystallization temperature is the temperature at which crystallization is induced. During crystallization, the heat of fusion raises the temperature of the sample to an ice/water freezing-point plateau.

Heat of Fusion: The heat released when the mobile molecules of a liquid are frozen into rigid ice crystals.

Freezing-Point Plateau: The constant temperature maintained during the time that ice and liquid exist in isothermal equilibrium after crystallization occurs.

Notes:

1 Installation & Setup

In order to set up your instrument properly, it is important that you read and follow the steps in this section. Please follow these steps carefully and be sure to read ***Chapter 2 — Instrument Operation*** *before attempting to run tests on your instrument.*

A. Things to do in advance

1. **Prepare bench space**. The dimensions of the Advanced 3D3 osmometer are listed in Appendix B. The area beneath the instrument should be kept clear and adequate space should be provided around the top and sides to allow unimpeded air circulation.

2. **Locate and test grounded outlet**. A three-prong grounded (earthed) 100-130V or 200-250V, 50-60Hz outlet capable of continuously supplying 2 amperes (1 ampere for 200-250V) is required within five feet of the instrument.

WARNING: This instrument must be properly grounded (earthed). The grounding pin of the power plug is connected to the cabinet to provide a noise shield around sensitive components.

If the instrument is not grounded properly, its operation will be impaired and a safety hazard may exist. It is not enough to simply plug the instrument into a grounding outlet. Have the outlet tested. Record the results.

3. **Obtain required items not supplied by the manufacturer:**
   - Soft, no-lint paper tissues for wiping the sample probe.
   - Clean, dry 0.2-mL or 0.25-mL pipette (see Chapter 2, section F).

B. Storage of supplies

Unopened calibration standards and reference solutions should be stored at 39ºF to 86ºF or 4ºC to 30ºC. Expiration dates are printed on the bottle labels. After opening, avoid contamination and evaporation; treat as recommended in Chapters 2 and 3.

The heat transfer fluid supplied with the instrument should be installed as described in section C below. A small amount of heat transfer fluid clings to the outside of each sample tube and some gradually evaporates; another container should be ordered now, in anticipation of its future requirement and may be stored at room temperature.

C. Installation

CAUTION Do not power the 3D3 for the first time until the voltage selection has been checked as instructed in this section.

NOTE Make sure the Supervisor/Operator keyswitch is in the Supervisor position as shown in figure 3, until power-up has been completed as instructed in section D.

Heat Transfer Fluid and Filter Installation

1. Momentarily press the top of the heat transfer compartment door to release the magnetic latch, then pull the door all the way open (see figure 4).

Figure 2: Model 3D3 Osmometer and Accessories

Quantity	Part No.	Description
1	3D3	The Advanced® Model 3D3 Osmometer
1 pack	3LA011	100 mOsm Standard
1 pack	3LA151	1500 mOsm Standard
1 pack	3LA301	3000 mOsm Standard
1 pack	3LA029	Clinitrol™ 290 mOsm Reference Solution
1	3LA827	1/16” Hex Wrench
2 bottles	3DA811	Heat Transfer Fluid
1	3D3185	Operator/Supervisor Keys (set of 2)
1	———	Power Cord (as specified)
1	3LA702	Probe/Stir Alignment Tool
1	3LA846	Sample Tube Rack
1	———	Sample Tubes Pack (re-order 500-pack as 3LA825)
1	3D35	User’s Guide
1	3D35-6	Warranty Card

Table 1: Model 3D3 Osmometer Packing List

2. Locate the bagged plastic tubes protruding through the back wall of the compartment. Remove and discard the plastic bag from the ends of the tubes.

3. A heat transfer fluid filter (figure 4, item 6) should already be mounted on the smaller of the two plastic tubes. If replacement is necessary, force the tubular end of the heat transfer fluid filter at least ¼" or 6 mm into the free end of the smaller of the two tubes.

4. Open a bottle of heat transfer fluid.

5. Insert the plastic tube with the heat transfer fluid filter into the bottle of heat transfer fluid so as to locate the filter at the bottom of the bottle for most economical usage of the fluid. The 3D3 will syphon heat transfer fluid into the freezing chamber as needed.

6. Insert the free end of the larger of the two plastic tubes into the neck of the heat transfer fluid container to return the heat transfer fluid to the container for recycling.

CAUTION The open end of the larger plastic tube must be *above* the surface of the heat transfer fluid for proper circulation if necessary, remove some fluid.

7. Stand the container of heat transfer fluid in the plastic tray in the heat transfer fluid compartment, **making sure the filter remains low in the heat transfer fluid.**

8. Close the compartment door.

NOTE When the heat transfer fluid level reaches the REPLACE line on the bottle label, discard remaining solution and replace the heat transfer fluid. Continued use when fluid is below this level will change the thermodynamics of the test.

Instrument Voltage Selection (see figure 3)

The 3D3 must be properly set for the voltage available on-site. The on-site power outlet voltage should have been recorded during the procedure recommended in section A.2.

Check the nominal voltage indicated beside the two matching arrowheads on the voltage selector/fuseholder in the back of the 3D3, below the power switch and power connector.

- If the AC voltage of the power outlet intended for the instrument is within the 100-130V range, the matching arrowheads should indicate 110-120V.
- If the power outlet AC voltage is within the 200-250V range, the matching arrowheads should indicate 220-240V.
- If the voltage selection requires correction, it can be accomplished by matching the proper arrowheads as follows:

    1. Unplug the power cord from the back of the instrument.
    2. Use a small screwdriver to pry the fuseholder out of the back of the instrument.
    3. Check the values marked on the two 5mm x 20mm fuses inside the fuseholder before re-installing. For 100-130V operation they

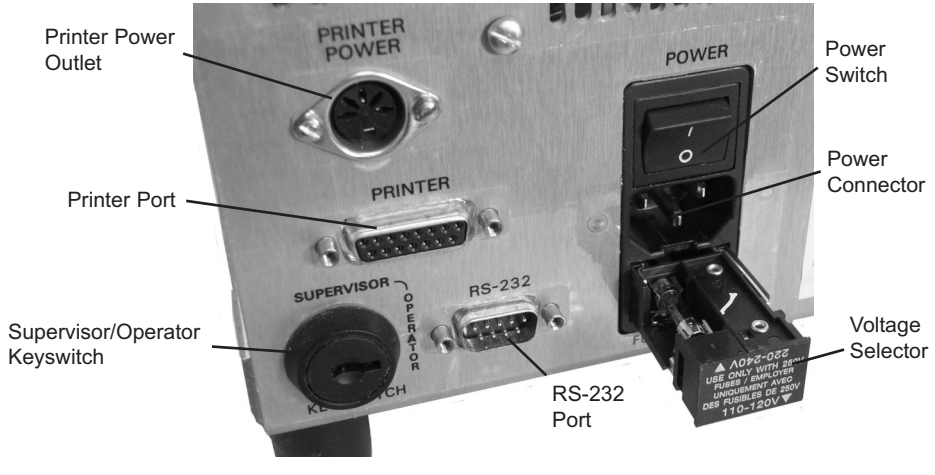

Figure 3: Back Panel

should be 2-Amp fuses; for 200-250V operation they should be 1-Amp fuses. Replace the fuses if incorrect.

4. Re-install the fuseholder into the back of the instrument with the correct arrowheads matching.
5. Connect the power cord to the 3D3 and the power outlet.
6. Proceed to section D below.

D. Power-up

Each time the 3D3 is turned on, it will sequentially display for a few seconds each, the software revision number, copyright notice, serial number, date and time, and the probe bin numbers, similar to the following:

```
Revision
3D3.A02.0
(C) 1994  A. I., Inc.
Serial #:123456789012
03/02/94  08:08 am
Block:  5  Sample:  3
```

Then the operating head will rise and "**Press START to Continue**" (or its equivalent in French, German or Spanish) will begin to scroll across the display. Maintaining a record of the information displayed will facilitate any necessary service.

All displayed messages will be in the language displayed at this time. To avoid any misunderstanding that might arise due to an unfamiliar display language, use the direct selection SETUP procedure described in Chapter 2, Section C.0 to select setup item 12 and follow the instructions in Chapter 2, Section C.12 to select a different display language.

Power up the 3D3 in the following manner:

1. If the 3D3 has been installed as instructed in sections A and C, turn the **POWER** switch *on* (**I**). The display will begin to scroll.

2. Record the displayed software revision and the block and sample probe bin numbers reported by your instrument in the service log in the back of the user's guide. The display does not pause for recording. If you need it repeated, turn the instrument off, pause, then turn it on again to reset the instrument.

   When all of the instrument data has been displayed, the operating head will rise and "**Press START to Continue**" will begin to scroll across the display. If for some reason the probe data has been lost from memory, "**Reset Probe Configuration**" will begin to scroll across the display after the instrument report instead of "**Press START to Continue**" and one should contact Advanced Instruments' Hot-Line® service before proceeding further (see Chapter 5, Section B).

3. When "**Press START to Continue**" begins to scroll across the display, make sure an empty sample tube is in the freezing chamber (figure 4, item 9).

   NOTE Step 4 must be accomplished before the 3D3 will cool the first sample.

4. If the instrument is being started for the first time, the heat transfer fluid pump should be "primed" using the **TEST** menu as follows:

   a. Make sure the Supervisor/Operator keyswitch is in the Supervisor position as shown in figure 3.

   b. Press the TEST switchpad. The display will change to "**Select Test Item**".

   c. Press the < switchpad once to step the display backward to "**Head Up/Down Test**".

d. Press the START switchpad. The display will change to "**[START] Test [STOP]**".

e. Press the START switchpad.

f. Allow the operating head to cycle down and up approximately twenty times to prime the heat transfer fluid pump. Then press the STOP switchpad to raise the operating head and exit to the test menu.

g. Press the STOP switchpad a second time to exit from the test menu to "**Press START to Continue**".

5. With an empty sample tube in the freezing chamber, press the START switchpad.

   The microprocessor will respond with the display, "Running Diagnostics", while it lowers the operating head, cools the freezing chamber and completes a series of internal diagnostic checks. If the diagnostic checks are not successfully completed or the freezing chamber does not cool properly, a diagnostic message will be presented.

   If the instrument has just been turned on, it takes a few minutes to cool the freezing chamber. If the heat transfer fluid pump has not been primed as described in step 4, the time will be longer.

   When the freezing chamber has been cooled and the internal diagnostic checks have been completed, the operating head rises, "Osmometer Ready" is displayed and an audible tone is sounded.

   If "Osmometer Ready" is not displayed at this point, turn the instrument off (O) for about 5 seconds, then on (I) again. If "Osmometer Ready" still does not appear, please refer to Chapter 5 for assistance.

Your 3D3 was calibrated at the factory. The probe and calibration parameters are stored in RAM which is powered by an internal battery when the instrument power is off or disconnected. Thus, when

"Osmometer Ready" is displayed, your osmometer is calibrated and ready to run.

NOTE If your 3D3 has just been moved from a colder location to its present environment, it should be allowed to warm up for 20 to 30 minutes before assuming that it should be recalibrated.

The 3D3 may be left on continuously. If it remains idle for five minutes or more, it automatically enters standby mode: the fan slows, the freezing chamber warms slightly and the display changes to the date and time. The 3D3 will remain in the standby mode until required to run a freezing-point test. When required to run a freezing-point test, the 3D3 will automatically exit the standby mode, speed up the fan and cool the chamber for the test.

CAUTION If a power interruption occurs, turn the instrument *off* at once. Leave it turned off for at least 5 seconds after power has been restored (to ensure internal circuitry is restarted properly), *even if power restoration is immediate.*

Please continue to Chapter 2 for operating instructions.

Notes:

2 Instrument Operation

In order to run your instrument properly, it is important that you read and adhere to the instructions in this section. For information on calibration, see ***Chapter 4 — Calibration.***

Hazardous material cautions

- **WARNING**: Handle all biohazardous materials according to established good laboratory practices and follow your institution's exposure control plan. Persons handling human blood and body fluid samples must be trained in blood-borne hazards and observe universal precautions. Universal precautions is an approach to infection control, where all human blood and body fluids are treated as if known to be infectious. Use personal protective equipment such as gloves, gowns, etc., to prevent exposure. Store biohazardous materials in regulated waste containers and dispose of these materials in a safe and acceptable manner that is in compliance with all country, state and local requirements.
- If a biohazardous material is spilled on or inside the equipment, decontaminate the equipment using a 1% bleach solution, or as outlined by those policies and procedures established within your institution.
- To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

A. Function of major components

Operation of the instrument will be quicker and easier if you become familiar with the locations and functions of the components, systems and controls described below before proceeding further.

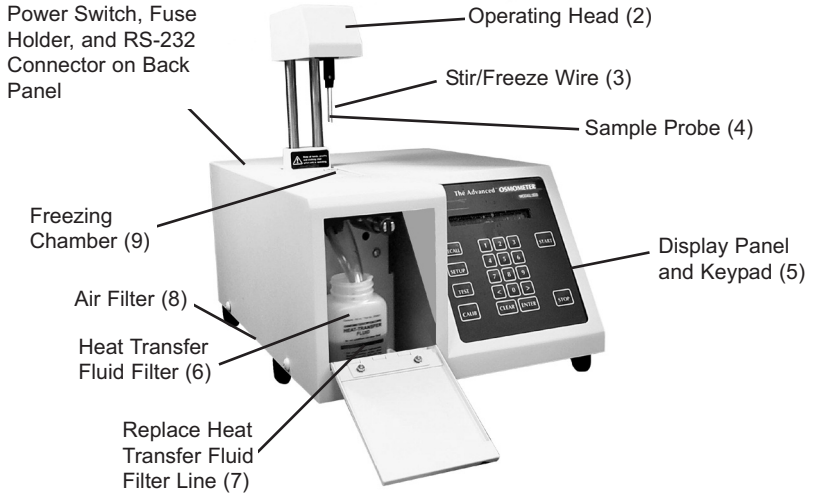
Power Switch, Fuse Holder, and RS-232 Connector on Back Panel
Operating Head (2)
Stir/Freeze Wire (3)
Sample Probe (4)
Freezing Chamber (9)
Display Panel and Keypad (5)
Air Filter (8)
Heat Transfer Fluid Filter (6)
Replace Heat Transfer Fluid Filter Line (7)

Figure 4: Model 3D3 Components and Controls

Functionally, this instrument consists of automatic sample holding and centering devices, a microprocessor-controlled freezing chamber, a precision digital thermometer, measurement and control circuitry and a message display panel. These basic systems include the following parts and controls:

1. **Power Entry Module** (see figure 3): Contains the following power components:

   a. **Power switch**: Press "I" for power on, "O" for power off. The power may be left on continuously; the 3D3 enters standby mode automatically if idle for more than five minutes.

   b. **Power cord connector**: To accommodate a power cord suitable for the power available.

   c. **Fuse** holder/voltage selector: For containing fuses suitable for the power available and for selecting the proper voltage (see Chapter 1, Section C).

2. **Supervisor/Operator Keyswitch** (see figure 3): The **Operator** position of the **Supervisor/Operator keyswitch** provides a means of locking out the setup, test and calibration functions of the instrument to help prevent unauthorized changes.

   The **Operator** keyswitch position allows access to the sample test function only; the **Supervisor** keyswitch position allows access to the setup, test and calibration functions, as well as the sample test function. It may be necessary or desirable, therefore, to complete some **SETUP** or **TEST** function (e.g., to prime the heat transfer pump as in Chapter 1, Section D.4) before locking the Supervisor/Operator keyswitch in the Operator position.

   If the **SETUP** or **TEST** switchpad is pressed while the Supervisor/Operator keyswitch is in the Operator position, a **"Supervisor Key Needed; Press STOP to Continue"** message is continually scrolled across the display until **STOP** is pressed. When **STOP** is pressed, the message will change back to **"Ready"**, re-enabling the sample test function.

   The **CALIB** switchpad has no effect until the instrument has completed the power-up diagnostic checks. If the **CALIB** switchpad is pressed after the instrument has completed the power-up diagnostic checks and the Supervisor/Operator keyswitch is in the Operator position, a **"Supervisor Key Needed; Press STOP to Continue"** message is continuously scrolled across the display until **STOP** is pressed.

3. **RS-232 Port** (see figure 3): The DB-9 RS-232 port conforms to the DTE RS-232C standard and has the following pin assignments (see table on next page).

   The serial port can reliably communicate over cable up to 10 meters in length. Data is transmitted asynchronously as 1 start bit, 8 data bits and 1 stop bit, with no parity. Hardware handshaking is supported; XON-XOFF software handshaking may be selected by means of the SETUP menu (see section C.7).

Signal	Pin	Direction
Carrier Detect	1	to 3D3
Receive Data	2	to 3D3
Transmit Data	3	from 3D3
Data Terminal Ready	4	from 3D3
Signal Ground	5	common
Data Set Ready	6	to 3D3
Request to Send	7	from 3D3
Clear to send	8	to 3D3

Table 2: Communications Port Connections

The default serial data rate is 1200 bps (bits per second), though 300 bps and 9600 bps may alternatively be selected (see section C.7).

Each message transmitted from the serial port is terminated by the sequence, Carriage Return (0D Hex), Line Feed (0A Hex), Null (00 Hex). For display purposes, most messages consist of less than 20 characters but longer messages, which scroll across the display, are transmitted no differently.

The 3D3 transmits a significant amount of information via the RS-232 port. Almost every item of information displayed by the instrument is transmitted over the RS-232 port, including test results, all error messages, and most display data from the "test" menu (see Chapter 5, Section F).

4. **Printer Power Outlet** (see figure 3): A 3-pin DIN socket on the back of the 3D3 automatically provides the proper power for the optional Advanced Instruments printer listed in Table 3 (if cable supplied with printer).

Printer Power Connections	
Pin 1 (left)	+12 VDC
Pin 2 (center)	not connected
Pin 3 (right)	ground

Table 3: Printer Power Connections

5. **Printer Port** (see figure 3): The printer port connector on the back of the 3D3 provides 8 data lines and the necessary handshaking signals for communication with most standard printers. The printer port connections are listed in Table 4.

NOTE If the printer does not print, make sure to check both the printer power and parallel cable connections before requesting service assistance as recommended in Chapter 5, Section B.

6. **Freezing Chamber** (figure 4, item 9): The freezing chamber is thermoelectric for reliability and precise control. The chamber contains a small amount of heat transfer fluid for optimum cooling capacity.

7. **Operating Head** (figure 4, item 2): The operating head contains a stir/freeze wire (item 3) with electrical means to vibrate it; an ultra-stable, ultra-precise thermistor sample probe (item 4) with devices to automatically locate the probe and sample in the freezing chamber.

8. **Measurement and Control Circuits** (inside): Microprocessor controlled. Provide operating mode and calibration selections on the display during SETUP. Automatically measure and control the dynamic temperature of the sample freezing chamber. Process calibration data and sample temperature information. Present calibrated test results on the digital display.

SIGNAL	PIN-OUT Port Connector	PIN-OUT Cable Output
STROBE	8	1
Data 0	2	2
Data 1	3	3
Data 2	4	4
Data 3	5	5
Data 4	6	6
Data 5	14	7
Data 6	7	8
Data 7	15	9
READY	1	11
Ret. Gnd	9	19
Ret. Gnd	10	20
Ret. Gnd	11	21
Ret. Gnd	12	22
Ret. Gnd	13	23

Table 4: Printer Port Connections

9. **Display Panel and Keypad** (figure 4, item 5): The microprocessor communicates with the instrument operator by means of alpha-numeric messages displayed on the illuminated display panel located at the top of the keypad. These messages report the instrument function currently being performed, the next operator function required and the results of tests. The messages are displayed either in English, French, German or Spanish, as selected via the SETUP menu (see section C.12); the default language is English.

The keypad contains spill-proof delineated pressure pads for operator input to the micro-processor. Keypad switch activation requires firm finger pressure to the center of the pad. When pressed properly the **RECALL, SETUP, TEST, CALIB, START** and **STOP** pads illuminate to indicate activation.

The function of each of the switchpads is as follows:

a. **RECALL**: Recalls the previous display (the last test result or the last message).

b. **SETUP**: Activates the SETUP menu which may be used to set the current date and time, activate the keypad "beeper", select the serial-port communication parameters, etc. (see section C).

c. **CALIB**: Activates calibration prompts for calibration of the instrument. Pressing STOP during a calibration test will cancel the test in progress; pressing STOP a second time will cancel recalibration and retain the previous calibration.

d. **TEST**: Activates a "test" menu for checking selected components and subsystems (see section D).

e. **Numbers 1 through 0**: Allow prompted numeric operator input, as required, during SETUP, CALIB and TEST procedures.

f. **< and >** : Allow stepping forward and backward through displayed menu items as an alternative to selection via the numeric pads and allows making alternative two-item menu choices.

g. **CLEAR**: Can be used to empty the date and time memory fields during **SETUP**. If sample identification has been enabled, **CLEAR** can also be used to empty the sample identification memory field.

h. **ENTER**: Confirms the selected **SETUP** menu item. If sample identification has been enabled, **ENTER** is used to confirm the sample identification.

i. **START**: Starts **CALIB, TEST** and **SET-UP** procedures, as well as freezing-point tests.

j. **STOP**: Cancels the procedure in process. During multiple step procedures such as calibration, pressing **STOP** once cancels the current test; pressing **STOP** a second time cancels the procedure.

B. Fluid check and startup

Momentarily press the top of the heat transfer compartment door to release the magnetic latch, then pull the door all the way open (see figure 4).

A container of heat transfer fluid and a heat transfer fluid filter are supplied with the 3D3 and should have been installed as instructed in Chapter 1, Section C. Two plastic tubes of different sizes should be observed, extending into the mouth of a container of heat transfer fluid.

The heat transfer fluid level should be visible through the semi-transparent container; if the heat transfer fluid level is below the "**REPLACE**" line marked on the container, it should be replaced. When finished, close the heat transfer fluid compartment door.

CAUTION The open end of the larger plastic tube must be above the surface of the heat transfer fluid for proper circulation; if necessary, remove some fluid.

If the date and time are being displayed, the 3D3 is in the standby mode, ready for a test to be run.

If the power switch on the back of the instrument is in the off (O) position and the power cord is connected to the 3D3 and the power outlet, place the power switch in the on (I) position.

Each time the 3D3 is turned on, it sequentially displays, for a few seconds each, the software revision number, copyright notice, serial number, date and time and the probe bin numbers. Then "**Press START to Continue**" will begin to scroll across the display.

Make sure an empty sample tube is in the freezing chamber (figure 4, item 9); then press the **START** switchpad. The microprocessor will respond with the display, "**Running Diagnostics**", while it lowers the operating head, cools the freezing chamber and completes a series of internal diagnostic checks. If the instrument has just been turned on, it will take a few minutes to cool the freezing chamber.

When the freezing chamber has been cooled and the internal diagnostic checks have been completed, the operating head rises, "**Osmometer Ready**" is displayed and an audible tone is sounded.

C. Setup

Your 3D3 has been individually setup at the factory for normal operation, but SETUP may be required for changing the date and time or customizing the SETUP parameters for your own individual needs.

NOTE
The Supervisor/Operator keyswitch must be in the **Supervisor** position to enable the use of the **SETUP** menu. If the SETUP switchpad is pressed while the Supervisor/Operator keyswitch is in the Operator position a **"Supervisor Key Needed; Press STOP"** message will be displayed (see section A.2).

The operating parameters that may be checked and set via SETUP are as follows, listed in numerical order.

Setup Menu Options
0. Select Setup Item
1. Set Block Bin #
2. Set Sample Bin #
3. Dis/Enable I.D. #
4. Set Stir Amplitude
5. Set Date/Time
6. Dis/Enable Beeper
7. Set Serial Rate
8. Dis/Enable Xon/Xoff
9. Serial Number
10. Select Range
11. Select "Buzz" Point
12. Select Language
13. Product/Test

Table 5: Setup Menu Options

Enter SETUP, if required, at **"Osmometer Ready"** or the date and time display, by pressing the **SETUP** switchpad. When **SETUP** is pressed, the display will change to **"Select Setup Item".**

There are two ways to select a **SETUP** menu item, direct selection and sequential selection, as described below:

0. Select Setup Item

This menu item is displayed first when **SETUP** is pressed and allows either direct selection or sequential selection of a menu item.

Direct Selection: for direct selection, press **START** at **"Select Setup Item".** The display will change to **"Setup Menu #: 0".** At **"Setup Menu #: 0",** enter the number of the desired setup item (from the list above) on the keypad and press **ENTER.** The display will change to the selected menu item.

Sequential Selection: for sequential selection, repeatedly press the **>** switchpad to step the display forward or **<** to step the display backward through the setup menu list. The displayed parameter list is cyclic; pressing > at the last item cycles the display to item 0. Continue pressing **>** or < until the desired menu item is displayed. Note that while direct, numerical selection is only available at

"Select Setup Item", > or < stepping is available from any menu position.

When the desired menu item is displayed, press the **START** switchpad to select the item, display the current setting and enable changing the setting.

The current setting is indicated either by the symbol **"*"** or a numeric value and may be changed by pressing > or < (or using the item-specific instructions below).

Press **ENTER** to store a new setting (or **STOP** to restore the original setting). The display will revert to the title of the parameter selected. Then one may press: **START** to display the new setting, > or < to step to the next **SETUP** item, **STOP** to exit the SETUP menu, or **TEST** to change to the TEST menu.

Recommended procedures for each of the other SETUP menu items are as follows:

1. Set Block Bin

This menu item displays the current block probe bin setting and allows the setting to be changed. However, the block probe bin setting should only need to be changed when a new block probe of a different bin number is installed. In that case, make sure the new block probe bin number is recorded in the service log in the back of the user's guide and proceed as follows.

NOTE Changing the bin setting requires re-calibration of the instrument.

At **"Set Block Bin #"**, press the **START** switchpad. The display will report the current block bin setting. Compare the current block bin setting with the new block bin number recorded in the service log.

If the current block bin setting is the same as that recorded in the service log, simply press the **STOP** switchpad to return to **"Set Block Bin #"**. If the current bin number is not the same as the new bin number, enter the required bin number by means of the numeric keypad.

Press **ENTER** to store the new setting (or **STOP** to restore the original setting).

Re-calibrate the instrument as instructed in Chapter 4.

2. Set Sample Bin

This menu item displays the current sample probe bin setting and allows the setting to be changed.

CAUTION Before changing the probe bin setting, the required setting should be determined by means of the procedure described in Chapter 5, Section F.3. Changing the bin setting requires re-calibration of the instrument.

At **"Set Sample Bin #"**, press the **START** switchpad. The display will report the current sample bin setting. Compare the sample bin setting with the sample bin number determined by means of the procedure described in Chapter 5, Section F.3.

If the current sample bin setting is the same as that determined in Chapter 5, Section F.3, simply press the **STOP** switchpad to return to **"Set Sample Bin #"**. If the bin number is not the same, enter the required bin number by means of the numeric keypad.

Press **ENTER** to store the new setting (or **STOP** to restore the original setting).

Re-calibrate the instrument as instructed in Chapter 4. Be sure to record the new sample bin setting in the service log in the back of the user's guide.

3. Dis/Enable I.D.

This menu item enables a means of entering an identification number for each sample test result. When enabled, each test prompts for an identification number to be entered via the numeric keypad. The identification numbers entered are displayed and sent to the printer port and the RS-232 port with the sample test results.

At **"Dis/Enable I.D. #"**, press **START** to display **" [on]< I.D.# * [off] ".** The current setting is indicated by the symbol, **"*"**.

At **" [on]< I.D.# * [off] "**, press < or > to toggle the I.D.# option on or off.

Press ENTER to store the new setting (or STOP to restore the original setting).

4. Set Stir Amplitude

This menu item displays the current sample stir amplitude setting and allows the setting to be changed.

At **"Set Stir Amplitude"**, press **START** to display **"Amplitude = xx".**

At **"Amplitude = xx",** look across the tip of the stir/freeze wire from the side to view and estimate the sample stir vibration amplitude. If properly adjusted, the stir/ freeze wire should vibrate principally fore and aft and should never strike the probe. The recommended stir amplitude adjustment procedure may be found in Chapter 5, Section G.5. Pressing > increases the stir amplitude; pressing < decreases the stir amplitude.

Press **ENTER** to store the new setting (or **STOP** to restore the original setting).

5. Set Date/Time

This menu item enables changing the date/time format and resetting the date and time.

At **"Set Date/Time",** press **START** to display the current date and time. Any change must be made in this order:

a. Press **CLEAR** to clear the entire setting and display the present format.

b. Use < to toggle to the date format you require ("**mm/dd/yy**" or "**dd/mm/yy**").

c. Use > to toggle to "**24hr**" format, "**am**" or "**pm**", as required.

d. Enter the current date and time (including zeros), via the numeric keypad, one digit at a time from left to right.

e. Press **ENTER** to store the new setting (or **STOP** to restore the original setting). If an invalid setting is attempted, the instrument will reject the setting and beep when **ENTER** is pressed.

6. Dis/Enable Beeper

The 3D3 keypad in itself has no audible indication that a key has been adequately pressed. The **"Dis/Enable Beeper"** menu item enables an audible indication.

At **"Dis/Enable Beeper"**, press **START** to display **" [on]< beeper * [off] "**. The current setting is indicated by the symbol, **"*".**

At **" [on]< beeper * [off] "**, press < or > to toggle the keypad beeper on or off. Neither selection will affect the invalid-selection beeper except that when the keypad beeper is on, an invalid selection will invoke two beeps; when off, only one.

Press **ENTER** to store the new setting (or **STOP** to restore the original setting).

7. Set Serial Rate

This menu item enables changing the serial rate of the data sent to the RS-232 port.

At **"Set Serial Rate"**, press **START** to display **"Serial Rate = xxxx".**

At **"Serial Rate = xxxx",** the serial-port baud rate may be reset by means of the < or > switchpad to either 300, 1200 or 9600 baud.

Press **ENTER** to store the new setting (or **STOP** to restore the original setting).

8. Dis/Enable Xon/Xoff

This menu item enables or disables the Xon/Xoff "handshaking" protocol for RS-232 communication.

At **"Dis/Enable Xon/Xoff"**, press **START** to display **" [on]< Xon/Xof *[off] "**. The current setting is indicated by the symbol, **"*"**

At **" [on]< Xon/Xof *[off] "**, press < or > to enable or disable serial-port Xon/Xoff handshaking.

Press **ENTER** to store the new setting (or **STOP** to restore the original setting).

9. Serial Number

At **"Serial Number"**, press **START** to display the instrument serial number **("Serial#: 123").**

Press **ENTER** to return to the setup menu.

10. Select Range

This menu item enables optimizing the 3D3 test parameters for a wider osmolality range than can be accommodated by a single set

of test parameters. Two ranges are provided: low range sets the 3D3 to operate between 0 and 2000 mOsm; high range sets the 3D3 to operate between 1400 and 4000 mOsm. Independent calibration parameters are maintained for each range. Calibration instructions are in Chapter 4.

Generally, each range requires a different crystallization temperature ("buzz" point). See item 11.

At **"Select Range"**, press **START** to display **" [low]* range >[high] "**. The current setting is indicated by the symbol, **"*"**.

At **" [low]* range >[high] "**, press **<** or **>** to toggle between the lowand high ranges.

Press **ENTER** to store the new setting (or **STOP** to restore the original setting).

11. Select "Buzz" Point

This menu item enables setting the temperature at which crystallization is induced by the freeze pulse (buzz) in each range.

Most freezing-point osmometers supercool all samples in the 0-2000 mOsm range to approximately 3000 on the mOsm scale. The 3D3 buzz points default to 3000 for the lower range and 5400 for the upper range.

Because the test results may be affected somewhat by the amount of supercooling, these default buzz points are recommended for general use and for the most reliable comparison of data.

Certain fluids may not freeze reliably at the default buzz point, however, or may give more repeatable results with either more or less supercooling than the default buzz point provides. The Model 3D3 is designed to accommodate these, as well as the more ordinary types of samples.

At **"Select "Buzz" Point**, press **START** to display the current crystallization setting, displayed as **"Buzz" Point = xxxx"**. To change the crystallization point:

a. At "**Buzz" Point = xxxx**", the present setting must be cleared before the buzz point can be changed. Press **CLEAR** to clear the setting.

b. Enter the desired buzz point (including zeros), via the numeric keypad, one digit at a time from left to right. Entries can be erased one digit at a time from the rightmost entry using the < switchpad. The 3D3 buzz points can be set between 2000 and 5400 on the mOsm scale.

Press **ENTER** to store the new setting (or **STOP** to restore the original setting).

NOTE Each time the buzz point is changed, the instrument displays the message "Check Calibration", a reminder that the instrument calibration is affected by the amount of supercooling.

12. Select Language

This menu item enables selecting English, French, German or Spanish display-panel messages.

At **"Select Language"**, press **START** to display the current setting.

Press < or > to select from available languages.

Press **ENTER** to store the new setting (or **STOP** to restore the original setting).

13. Product/Test

Product/Test is for factory use only and has no field function.

D. Test

The **TEST** switchpad activates a menu-driven program for testing instrument functions (see Table 6). Instructions for performing these tests are in Chapter 5, Section F.

Test Mode Options
1. A/D Tests
2. Stir/Freeze Test
3. Probe Bin Test
4. Serial Loop Test
5. Display/Print Test
6. Beeper Test
7. Keypad Test
8. Head Up/Down Test

Table 6: Test Mode Options

E. Sample preparation

No further preparation is required. Body fluids such as serum or plasma may be used directly.

NOTE Additives such as anti-coagulants from collection tubes may contribute significantly to the measured osmolality.

Particulate matter can cause premature crystallization; in blood it is normally eliminated by centrifugation. Particulate matter in urine may be removed by centrifugation or filtration through an inert filter.

F. Sample tubes and sample sizes

Different sample tube styles and sample sizes should not be intermixed because each may require a different instrument adjustment and/or calibration. Sample tubes should be as uniform as possible in composition, shape and size.

Glass tubes generally are not as uniform in shape and size as plastic tubes, nor do they thermally isolate test samples as well. The 3D3 operating parameters are optimized for Advanced Instruments plastic sample tubes - do not expect the same repeatability using glass tubes. If you need further information concerning sample tube requirements, please contact Advanced Instruments as recommended in Chapter 5, Section B.

Samples should always be pipetted or measured; 0.25-mL or 0.2-mL samples may be used, in Advanced Instruments sample tubes. To achieve the performance specified in Appendix B, we recommend that you use 0.25-mL samples; 0.2-mL samples require somewhat more critical probe and stir/freeze wire adjustments for similar precision in results. The 3D3 should be calibrated with the same sample size used for testing.

G. Sample test procedure

Like most measuring instruments, osmometers need calibration against standards. Both the high and low ranges of your Advanced Model 3D3 were calibrated at the factory using the procedure described in Chapter 4. The probe and calibration parameters are stored in parameter RAM which is powered by an internal battery when the instrument power is off or disconnected. Thus, when "**Osmometer Ready**" is displayed, your 3D3 osmometer is calibrated and ready to run. However, the calibration should always be verified during operation to be sure that none of the parameters affecting calibration have changed. (If re-calibration is required, see Chapter 4.)

Instrument operation in the following manner is recommended:

1. Remove the sample tube from the freezing chamber (figure 4, item 9).

2. Gently wipe the probe, stir/freeze wire, mandrel and the top of the freezing chamber (in that order) with a soft, lint-free, non-ionic paper tissue dampened with distilled water to remove anything that

might contaminate the sample to be tested. Be careful not to bend the probe or stir/freeze wire.

3. Select a reference solution or NaCl standard with a freezing point close to that expected for your unknown (Advanced Clinitrol™ reference solution is recommended for serum). Swirl and carefully open an ampule of the reference solution (or NaCl standard) selected.

   If the expected freezing point is in the 2000-4000 mOsm range, the 3D3 **High** range should be selected (see section C.10). If the freezing point is not within the range selected, an error message will be displayed, requesting the range to be changed.

4. Select a clean sample tube (see Repeatability Tips).

5. Pipette or measure (see section F) a sample of the selected reference solution or NaCl standard into the clean sample tube and place the tube in the freezing chamber.

6. Press the **START** switchpad.

   If **I.D.#** has been enabled via the setup menu (see section C.3), the instrument operator will be prompted for a sample or user identification number of up to 13 digits at this time.

   At the "**I.D. #** " prompt, the present setting may be retained by pressing **ENTER**.

   The present setting may be erased entirely by pressing **CLEAR** or erased one digit at a time from the right by repeatedly pressing **<.**

   A new number may be entered one digit at a time from the left via the numeric keypad.

   Press **ENTER** to store the new setting and continue the test. "**Press START to Continue**" will begin to scroll across the display.

   Press **START** (Pressing **STOP** would cancel the test).

The rest of the test is completely automatic. The operating head will lower the sample probe into the sample tube in the freezing chamber. The fan will come up to full speed and the freezing chamber will cool.

The sample temperature will follow the freezing curve shown in figure 1 and will be displayed as soon as it falls below 0°C.

The 3D3 will freeze the sample at a crystallization point established by the range and "buzz" point selections, follow the plateau development, determine the osmolality and lock the result on the display.

NOTE If the STOP button is pressed while a test is in progress, the test will be discontinued and the 3D3 will reset itself for the next test.

7. When the display reads "**Osmolality XXX mOsm**", the test results may be recorded.

   NOTE If the wrong osmolality range has been selected, an error message will replace the osmolality report. Use the procedure described in section C.10 to select the required range; then test another aliquot.

8. Gently wipe the probe, stir/freeze wire, mandrel and the top of the freezing chamber (in that order) with a soft, clean, dry, lint-free paper tissue after each test, to avoid contaminating the next sample. Be careful not to bend the probe or stir/freeze wire.

9. Repeating steps 1-8, test two to four more aliquots of the same reference solution or standard to check repeatability and accuracy before running tests on unknown samples. Follow the techniques recommended in Repeatability Tips. When checking calibration and repeatability with standards or reference solutions, it is usually best to average the readings from three to five aliquots of each sample to avoid error.

If you are running the instrument for the first time, it is recommended that you follow the Clinitrol™ reference solution samples with bracketing calibration standards to check the instrument accuracy and linearity over the range of interest.

If the instrument accuracy on the reference solution (and/or calibration standards) is not satisfactory, refer to Chapters 3 and 4.

If the instrument repeatability on the reference solution (and/or calibration standards) is not satisfactory, review Repeatability Tips.

10. If the accuracy and repeatability on the reference solution (and/or calibration standards) are satisfactory, you may begin testing unknown samples, using exactly the same test procedure as for the reference solution and standards.

11. Always wipe the probe, stir/freeze wire, mandrel and the top of the freezing chamber with a soft, clean, dry, lint-free paper tissue after the last test, to avoid having contaminating material dry on the probe.

12. Leave an empty sample tube in the freezing chamber to help avoid having to clean out accidently-introduced material.

The 3D3 may be left on continuously. When idle for five minutes or more, it automatically enters standby mode: the fan slows, the freezing chamber warms slightly and the display changes to the date and time. The 3D3 remains in the standby mode until another test is needed. It automatically exits from standby mode when any keypad is pressed.

NOTE When the instrument enters the standby mode with a determination on the display, the display will change to the date and time but the last previous display may be recalled by pressing **RECALL.** However, if the instrument is shut off during standby, the RECALL buffer is emptied.

Repeatability Tips

1. Sample tube cleanliness is extremely important for repeatability. New Advanced plastic sample tubes may be expected to be clean. If glass tubes are preferred, they should be washed in hot water containing a non-ionic detergent, rinsed in distilled water, and thoroughly dried before each use.
2. Always treat all samples uniformly before the test. Treat standards and reference solutions the same as the unknowns. Do not intermix different tube styles.
3. Glass tubes generally are not as uniform in shape and size as plastic tubes, nor do they thermally isolate test samples as well. The 3D3 operating parameters are optimized for Advanced Instruments plastic sample tubes-do not expect the same repeatability using glass tubes.
4. To avoid contamination and evaporation, cover all samples not immediately being tested.
5. Use the same sample size consistently (i.e., during calibration, testing, etc.).
6. For repeat runs, use another sample from the same source or thaw the original sample before repeating. If you must rerun the same sample or use it for another procedure, remove it from the freezing chamber as soon as possible and keep it covered between tests.
7. Always use the same operating procedure as described in section G, as proper, consistent procedure is the key to repeatable results.

Repeatability Tips

8. The first reading in any given period of operation may be slightly off because of temperature conditioning or residual contamination of the probe. Subsequent readings on aliquots of the same sample should group within the specifications listed in Appendix B if you practice good operating techniques (section G).
9. If an occasional sample produces irregular results, discard obviously discrepant readings as long as the instrument has been producing accurate readings repeatedly. Repeat the reading in question.

If all instructions are followed carefully and the instrument still will not repeat, it is possible that the probe has been damaged. The probe may be checked as recommended in Chapter 5, Section G.3. If a new probe is installed, the sample probe bin number must be reset as instructed in Chapter 2, Section C.2, and the instrument must be re-calibrated as instructed in Chapter 4. If the instrument is still not repeating, please call or write your dealer or Advanced Instruments immediately for Hot-Line® service as instructed in Chapter 5, Section B.

3 Standards & Quality Control

A. Purpose of quality control

The purpose of quality control is to ensure that the results obtained through laboratory analysis are correct, that is, that the results obtained are the closest to the truth that the analytical technology used is able to determine.

B. Repeatability and accuracy

Two important measures of quality control are repeatability and accuracy. Repeatability is sometimes called "reproducibility" sometimes "precision". However described, repeatability is essential in nearly all forms of measurement, and is fundamental to accuracy. Repeatability is not accuracy; repeatability underlies accuracy. Repeatability is a measure of the ability of a method to obtain the same result time after time on the same sample.

Repeatability or precision is usually quantified as the standard deviation (S.D.) of a set of measurements normally distributed about a mean: ±1 S.D. about the mean denotes the range of values within which 68% of the measurements will fall; ±2 S.D., 95%.

By contrast, accuracy is a measure of how close to the "true" value a method or measuring device has come. One can repeat without being accurate, but one cannot be accurate without repeating well.

C. Standards and controls

To be accurate, all measurements ultimately must be referred to highly reliable independent standards. Advanced osmometers are calibrated with standards consisting of stable sodium chloride solutions of known freezing points which bracket those of the expected unknowns. These standards are related to the most fundamental work on freezing points of dilute solutions published and are traceable to the National Institutes of Standards and Technology (formerly the National Bureau of Standards).

However, the most important osmometer determinations are made, not on sodium chloride, but on biological solutions. How accurately they determine the freezing points of precisely-known concentrations of sodium chloride solutions, therefore, is only one measure of osmometer accuracy. Another measure should involve determinations on biological solutions or controls formulated to synthesize biological solutions.

The Advanced Protinol® protein-based controls, at 240, 280 and 320 ±5 mOsm, provide control values which closely bracket those of most serum samples. Other commercially available biological controls may be recommended or specified in your area but are not quality controlled by Advanced Instruments. The Advanced 3LA028 Osmolality Linearity Set provides two 5mL ampules each of 100, 500, 900, 1500, and 2000 mOsm NaCl standards for verifying osmometer linearity in accordance with CLIA guidelines.

Please check with your associations and regulatory bodies for their guidelines and/or requirements.

D. Maintenance of standards

Doubts about the accuracy of standards destroy confidence in the accuracy of the test. The Advanced osmometer standards are specified to be within very close tolerances. Several of the sodium chloride based ref-

erence and calibration solutions designed for the Advanced osmometers are sealed in glass ampules to insure against any possibility of alteration during transit or storage. However, we recommend that you test samples from each newly-received lot and maintain records of your test results on osmometer standards for reference.

E. Quality control implementation

The following recommendations outline the minimum requirements for quality control:

1. Read, understand and follow the instructions and recommendations in the user's guide as closely as practical.

2. The instrument repeatability and accuracy should be checked each time it is used, as recommended in step 10 of the sample test procedure outlined in Chapter 2, Section G. Run at least two levels of standards or controls daily. Prepare, maintain and follow additional verification procedures specifically adapted to your own laboratory requirements as necessary.

3. Instrument repeatability is specified in Appendix B. It depends to a certain extent upon operator technique and can usually be improved by carefully following the Repeatability Tips in Chapter 2.

4. Instrument accuracy is determined by comparing your results on precisely-known standards and/or controls with their specified values. The instrument accuracy is adjustable; if it is unsatisfactory, it should be corrected by re-calibrating, as instructed in Chapter 4. However, it has been shown that frequent unnecessary re-calibration will introduce inaccuracy. The calibration of a freezing-point osmometer in good condition and properly operated will not shift or drift.

Notes:

4 Calibration

This chapter describes the procedure for calibrating your instrument. If you have questions or problems regarding the calibration procedure, please consult ***Chapter 5 — Troubleshooting & Service****.*

Aside from requiring manual range selection and sample introduction, calibration of the 3D3 is automatic. Following the procedure suggested below, you simply make sure the Supervisor/Operator keyswitch is in the **Supervisor** position, use the SETUP menu to select the required range (see Chapter 2, Section C.10), then press **CALIB** to initiate freezing-point tests on each of the two calibration standards required for the selected range.

The calibration standards required are:

Low range: 100 and 1500 mOsm/kg H_2O
High range: 1500 and 3000 mOsm/kg H_2O

Internally, the 3D3 accomplishes calibration in two steps for each range. First it records the raw means of the results of freezing-point tests on standards at each of the two calibration levels. Then it performs the necessary conversion calculations and calibrates the display. Each range is independently calibrated.

Check the calibration frequently, as recommended in Chapter 2, Section G, but do not re-calibrate when the calibration is satisfactory. It has been shown that unnecessary re-calibration will introduce inaccuracy. The calibration of a freezing-point

osmometer in good condition and properly operated *will not shift or drift*.

Both the **High** and **Low** ranges were initially calibrated at the factory. To re-calibrate either range, proceed as follows:

1. Make sure the Supervisor/Operator keyswitch remains in the **Supervisor** position until re-calibration has been completed (see figure 3 and Chapter 2, Section A.2).

2. At **"Osmometer Ready"** (or the date and time standby display), use the SETUP menu, as necessary, to select the required range (see Chapter 2, Section C.10); then press **CALIB**. The **CALIB** switchpad will light and the display will quickly change to **"Calibration"**, then prompt you for the first calibration standard.

NOTES

a. Your 3D3 will retain its previous calibration until re-calibration has been completed and the display reads **"Calibration Complete"**.

b. Pressing **STOP** during a calibration test will cancel the current test but allow calibration to be resumed with another sample. Pressing **STOP** a second time will cancel re-calibration and retain the previous calibration.

c. If the instrument has calibration information in memory, the first test result displayed should be very close to the nominal value of the standard loaded. If the instrument has *no* calibration information in memory, the test result displayed may be far from the nominal value of the standard loaded; if the displayed values repeat consistently, the calibration will be automatically adjusted when the calibration test sequence has been successfully completed.

d. If the instrument has calibration information in memory, the 100-mOsm low-range calibration level may be skipped by pressing the **CALIB** switchpad a second time.

e. Although it is possible for the 3D3 to detect certain gross calibration errors such as reversal of the standards, it remains the responsibility of the operator to be sure to introduce accurate standards of the specified freezing-point values.

3. Observing the Repeatability Tips recommended in Chapter 2, load the standard sample prompted by the display into the freezing chamber and press **START**. The display will change to **"Cooling Sample"**, the operating head will lower, a calibration test will be run and the results will be displayed and recorded internally.

   Continue loading and testing standard samples at the first calibration level **until prompted by the display for samples at the second calibration level**. At least two samples are required at the first calibration level of the **Low** range; more may be necessary. *Do not load samples at the second calibration level until prompted by the display to do so.*

   At least six samples are required at the second calibration level of the **Low** range and at each calibration level of the **High** range.

4. When calibration tests have been completed at the first calibration level, the instrument will calculate and store the mean of the raw values of the tests, then prompt the operator for samples at the second calibration level. The calibration will not actually be changed until calibration tests have been acceptably completed at the second calibration level of the selected range.

NOTE

Good operating technique (see Chapter 2) is as important during calibration as during normal operation. If the calibration test results are not acceptably repeated, the instrument will report **"Calibration Out of Range"** and the calibration procedure must be redone. If the repeatability problem recurs despite good operating technique, please call or write your dealer or Advanced Instruments immediately for Hot-Line® service as instructed in Chapter 5, Section B.

When the required calibration tests have been acceptably completed at the second calibration level, the instrument will calculate and store the mean of the raw values, re-calibrate the readout and display **"Calibration Complete"**.

5. If you need to re-calibrate the other range, use **SETUP** to change the range and **CALIB** to re-start the calibration sequence for the second range.

   If re-calibrating only one range or if re-calibration of both ranges has now been completed: at **"Calibration Complete"**, press **STOP** to return to **"Osmometer Ready"** or load a test sample into a sample tube, place it in the freezing chamber and press **START** to lower the operating head and begin a regular test.

5 Troubleshooting & Service

This chapter contains very basic information to help you solve problems that might arise with your instrument. Please read all instructions very carefully, and if a solution cannot be found in this guide, contact Advanced Instruments for Hot-Line® Service.

A. Service & maintenance cautions

- Do not perform any service or maintenance yourself, except as detailed in the User's Guide.
- Unplug the power cord prior to opening or removing covers, or else you may be exposed to electric shock, excessive temperatures, or mechanical hazards.
- Performing service or maintenance not detailed in the User's Guide, with or without a Service Manual, should only be done by a qualified service technician.
- Never restrict airflow into or out of the product. Occasionally, check the air vents for blockage.
- Wipe the exterior of the product with a soft, damp cloth as needed. Using cleaning products other than those specified, may discolor or damage the finish.
- If the product requires service for any of the following reasons, unplug the product from the electrical outlet and refer service to a qualified service technician.
  - The power cord, extension cord, power strip, or power input module is damaged.
  - Liquid has been spilled into the interior of the product.

- The product is equipped with operator accessible fuses. If a fuse blows, it may be due to a power surge or failure of a component. Replace the fuse only once. If the fuse blows a second time, it is probably caused by failure of a component part. If this occurs, refer service to qualified service personnel. Always replace the fuse with one of the same rating, voltage, and type. Never replace the fuse with one of a higher current rating.
- When servicing the product, use only factory-specified parts.
- **WARNING**: When returning this product for service, or shipping this product to a second location, remove all hazardous specimens and decontaminate the product before packaging for shipment. If the product cannot be decontaminated, consult with your shipping agent on appropriate packaging and marking.

B. Obtaining service

Before contacting Advanced Instruments for Hot-Line® Service, be sure to read through this user's guide for instructions on routine adjustments, instrument care and troubleshooting. If this information does not solve your problem, call the appropriate number below.

- 800-225-4034 (toll-free within the USA and Canada)
- +US 781-320-9000 (elsewhere)
- 781-320-0811 (fax)

If you purchased your instrument outside of the U.S. or Canada, please contact your Advanced Instruments authorized dealer for service or repair.

When contacting our service personnel, please have the model and serial numbers from the label on the back of your instrument, your user's guide or service manual, and the symptoms of your problem ready. You should use a telephone as close to your instrument as possible to facilitate making recommended diagnostic checks. If you need to order parts or service, a purchase order from your purchasing agent will be necessary.

After Hot-Line diagnosis, your service technician may assist you in making minor repairs over the phone, dispatch a local service representative, or have you ship your instrument for factory repair.

To return an instrument for repair or replacement:

1. Notify our service department to obtain an RMA.
2. Open the heat transfer fluid compartment in the front of the instrument. Remove the fluid filter and smaller plastic tube from the heat transfer fluid container; temporarily leave the larger plastic tube in the heat transfer fluid container.
3. Place an empty sample tube in the freezing chamber. Run the Head Up/Down Test for a few minutes to pump the heat transfer fluid remaining in the system out into the heat transfer fluid container. Remove, cap and retain the heat transfer fluid container.
4. Tape or tie a small plastic bag over the ends of the heat transfer fluid plastic tubes and fluid filter to retain any leakage. Lower the operating head into the empty sample tube in the freezing chamber to protect the probe during shipment.
5. Carefully pack and send everything except supply items.

Be sure to prepay for any shipment to the factory. Advanced Instruments cannot accept collect shipments without prior factory approval. Please insure the shipment, or accept the damage risk.

C. Routine maintenance

Daily. Checks you should perform to keep your instrument in peak condition are:

1. Calibration Repeatability: Readings each day on separate aliquots of the same standards should not deviate beyond the repeatability and drift limits indicated in Appendix B.
2. Heat-transfer fluid: Heat-transfer fluid will evaporate from the well and droplets will cling to the sample tubes as they are removed. Check the contents of the heat transfer fluid reservoir

occasionally; replace the fluid when the level drops below the "REPLACE" line on the bottle.

Monthly. Maintenance you should perform:

Clean the air filter (figure 4, item 8) monthly; replace as necessary. A dirty filter affects the ability of the fan to cool internal components; a rise in internal temperature may adversely affect reliability.

D. Shutdown and storage

Overnight or weekend:

1. Rinse the probe clean with distilled water and wipe it dry.
2. Turn the instrument off, if desired.
3. Do not cover the instrument unless it is turned off.

One week or longer:

1. Rinse the probe clean with distilled water and wipe it dry.
2. Turn the instrument off.
3. Unplug the power cord from the wall outlet.
4. Cover the instrument.

E. Troubleshooting

There are several levels of troubleshooting available to users of the Advanced 3D3 Osmometer. The lowest level simply involves requesting help as recommended in section B but it will facilitate obtaining help if you can do some simple guided troubleshooting (and possibly avoid embarrassment if the solution is merely a matter of making sure the instrument is properly powered and that you are using the correct standard solutions).

Before assuming that the instrument itself is faulty, carefully review the operational requirements listed in Appendix B and the recommended setup and operating procedures in Chapters 1, 2, and 4. If the problem

involves apparently-anomalous results, the procedures and recommendations in Chapter 2, Section G and Repeatability Tips should be reviewed, and the standards and reference solutions verified, as recommended in Chapter 3.

The middle level of troubleshooting involves choosing and making whatever common-sense checks and tests you are comfortable with and, if a solution is not quickly apparent or readily accomplished on site, then requesting help. This level is, for the most part, covered by two sets of built-in tests designed to aid service diagnosis in the field, the power-up tests and the diagnostic menu tests, as well as the troubleshooting table and sections F and G which follow.

Each time the instrument is turned on, it performs power-up tests to determine whether it is operable. When "**Osmometer Ready**" appears on the display, the instrument is ready to operate.

If the instrument displays an error message during a test, the first corrective action in most cases simply involves repeating the test, paying more careful attention to procedure and technique. If an error message again results, the message will either be self-explanatory or described in the troubleshooting table.

The troubleshooting table contains a selected list of instrument problems and corrections which may be accomplished by most technicians. If recommended in the troubleshooting table, running an appropriate diagnostic menu test from those described in section F may provide more information. Section G contains some additional tests and adjustment and replacement instructions.

The highest levels of troubleshooting and field service may require much more technical ability and probably should be accomplished by your dealer or at the factory. However, if your circumstances require more extended troubleshooting information than provided in this user's guide, a service manual is available, as indicated on the enclosed supplies and accessories list.

Whatever level of troubleshooting you attempt, please record all of the symptoms you observe. Do not depend upon memory. Then call for help as necessary.

F. Test

Pressing **TEST** at "**Osmometer Ready**" or the date and time display, activates a menu-driven program beginning with "**Select Test Item**".

NOTE The Supervisor/Operator keyswitch must be in the **Supervisor** position to enable the use of the TEST menu. If the **TEST** switchpad is pressed while the Supervisor/Operator keyswitch is in the **Operator** position a "**Supervisor Key Needed; Press STOP**" message will be displayed (see Chapter 2, Section A.2).

At "**Select Test Item**", the following tests are available:

0. Select Test Item
1. A/D Tests
2. Stir/Freeze Test
3. Probe Bin Test
4. Serial Loop Test
5. Display/Print Test
6. Beeper Test
7. Keypad Test
8. Head Up/Down Test

An item on the TEST menu may be selected in either of the following two ways:

At "**Select Test Item**", repeatedly press the > switchpad to step the display forward or the < switchpad to step the display backward through the list. The list is cyclic; pressing > at the last item cycles the display to item 0. Continue pressing > or < until the desired test is displayed. While the desired test is displayed, press the **START** switchpad.

Or, at "**Select Test Item**", press the **START** switchpad. The display will change to "**Test Menu #: 0**". From the list above, type the number of the desired test on the numeric keypad. The "**0**" on the display will change to the number typed, if valid. Then press **ENTER**. The display will show the selected test. Next, press the **START** switchpad. The requirements are different for each test but are guided by the display.

Press **STOP** to end the test. The display will revert to the title of the test selected. Then one **STOP** to exit the test menu may press: > or < to step to the next test, **STOP** to exit the test menu, or **SETUP** to change to the SETUP menu.

Descriptions of the test menu items and instructions for their use follow:

1. A/D Tests

This set of tests may be used to test the block probe, the cooling assembly and the sample probe. The A/D tests may also be used to check the accuracy of the A/D conversion channel or to monitor the A/D channel for drift over time or temperature (by temporarily replacing the sample probe with a precision resistor).

Place a sample tube in the cooling well before running the A/D tests.

On entry, the A/D tests display the target cooling-block temperature, the channel being read and the current channel reading or duty cycle. The display is in the form, "**off Blk NNNN.NN ohm**", where "**off**" indicates that a target temperature has not yet been selected, "**Blk**" indicates that the block probe channel is being tested, "**NNNN.NN**" is a numeric readout of the probe (or resistor substituted for the probe), and "**ohm**" indicates the units of the readout. These readings are updated continuously.

Pressing the < switchpad sequentially changes the target cooling block temperature from "**off**" to "+**1**", to "**-8**", to "**off**", etc.

Pressing the > switchpad sequentially changes the channel and readout units:

from block-probe resistance in ohms,
to sample-probe resistance in ohms,
to block temperature in tenths of a degree Celsius,
to sample temperature in tenths of a degree Celsius,
to cooling-block duty cycle,
to block resistance in ohms, etc.

CAUTION The temperature values displayed are based on the block probe resistance which the instrument is configured for. Thus, if the block probe bin number has been incorrectly set, both the displayed temperatures and resistances will be incorrect, as well as the actual temperature of the freezing chamber.

While the target temperature is "**off**", the block probe is warm and its resistance should be less than 4,990 ohms. The resistance window of the A/D channel is 4,990 to 10,558 ohms, so the display should continuously indicate 4990.00 ohms until a target cooling block temperature has been selected.

Press **STOP** to raise the operating head and exit to the test menu.

2. Stir/Freeze Test

This menu item enables visually and aurally checking the stir and freeze vibration amplitudes. Please refer to sections G.4 and G.5 for instructions.

3. Probe Bin Test

This test is used to determine the resistance and bin number of the sample probe at a specific temperature (-0.093ºC). It is essentially

the same as any other sample test except that the sample probe resistance and correct bin number are determined and displayed, in place of the sample freezing point.

On entry, the probe bin test will display "**[Start] Ready?**".

At "**[Start] Ready?**", pipette or measure a sample of probe bin-setting fluid into a clean sample tube, place the tube in the freezing chamber and press the **START** switchpad. The 3D3 will run a special freezing-point test to determine the sample probe resistance and bin number.

NOTE
In emergency, H_2O may be used in place of probe bin-setting fluid for this test. The bin number thus determined will be acceptable for bin setting though the probe resistance displayed will be that at the freezing point of the H_2O sample used and will be different from that at a freezing point of -0.093ºC.

The display will flash "**Cooling Sample**" (as in a normal test) until the sample probe resistance reaches 4990 ohms. Then the test proceeds normally, except that the display is in ohms rather than mOsm. At the end of each test, the final display will be the test result in ohms and the sample probe bin number (e.g., "**12345.67 Ohms Bin 10**").

A test in progress can be stopped by pressing the **STOP** switchpad. Another test may be run by replacing the sample and pressing **START** again. At a specific freezing point, each probe has a unique resistance which should vary very little from test to test. Therefore, the results of this test may be used as a troubleshooting aid, in conjunction with the sample-probe checks described in section G.3.

Record the sample probe resistance and bin number in the service log in the back of the user's guide (and/or other convenient location); then press the **STOP** switchpad. The display will change to "**Probe Bin Test**".

Press **SETUP** and use the procedure described in Chapter 2, Section C.2 to reset the sample probe bin setting as necessary.

NOTE Re-calibration is required each time the sample probe is replaced and/or the sample probe bin number is reset.

If running this test produces the message, "**Reset Probe Configuration**" instead of the sample probe resistance and bin number, the sample probe bin number is not available from the instrument memory and must be reset. Press **SETUP** and use the procedure described in Chapter 2, Section C.2 to preset a random sample probe bin number such as "**5**". Then press **TEST** and re-run the probe bin test. Finally, as necessary, press **SETUP** and use the procedure described in Chapter 2, Section C.2 to correct the sample probe bin setting. If the "**Reset Probe Configuration**" message persists, refer to section B for further assistance.

4. Serial Loop Test

This test performs a continuous check of the serial port.

NOTE **Before** pressing the **START** button to begin this test, a temporary jumper connector must be installed on the RS-232 connector on the back panel of the 3D3 (see figure 3) to make the following loop-back connections:

pin 1 to pin 7
pin 7 to pin 8
pin 2 to pin 3
pin 4 to pin 9
pin 4 to pin 6

On entry, the serial loop test displays "**[START] Loop Ready?**".

Press the **START** switchpad to run the test. The instrument will begin to continuously send characters to the RS-232 port and dis-

play a count of the number of characters sent and the number of over-run/framing errors that occur or will display the message, "**Serial Loop Failed**". After a serial loop failure, the test may be re-run by pressing the **START** switchpad.

Press **STOP** to exit to the test menu. Then remove the temporary loop-back connector.

CAUTION If the loop-back connector is not removed after this test, the instrument will not function.

5. Display/Print Test

This test is a simple check of the display and printer (if a printer is connected to the printer port).

On entry, a series of characters should scroll across the display (and a single line of the same characters should print out on the printer). The characters displayed have been chosen to illuminate every dot in the character matrix. This makes it possible to distinguish any dots that no longer work, on the printer as well as the display.

Press **STOP** to exit to the test menu.

6. Beeper Test

This test exercises the beeper.

On entry, "**[on] beeper [off]**" is displayed. Press the < switchpad to cause the beeper to beep repeatedly; press the > switchpad to stop the beeper.

Press **STOP** to exit to the test menu.

7. Keypad Test

This test enables checking each switchpad on the keypad, as well as the lamps of each illuminated switchpad. As each switchpad is pressed, its name should be displayed and the lamp of each illuminated switchpad should light.

Press the **STOP** switchpad to exit to the test menu after a momentary pause.

8. Head Up/Down Test

This test continuously cycles the operating head down and up.

CAUTION To protect the sample probe, place a sample tube in the freezing chamber before running this test.

On entry, "**[START] Test [STOP]**" is displayed. Press **START** to continuously cycle the operating head.

Press **STOP** to raise the operating head and exit to the test menu.

Press **STOP** to exit from the test menu to "**Osmometer Ready**" (if the initial diagnostics had not been completed when the test menu was entered, the 3D3 will complete them before "**Osmometer Ready**" is displayed).

G. Adjustment and replacement of parts and assemblies

1. Air Filter Replacement

The air filter (figure 4, item 8) should be cleaned or replaced monthly or whenever it becomes clogged with dust to the point where samples cool more slowly than normal.

a. Remove the filter by gripping the edge of its square finger-hole and pulling straight out.

b. Push a new air filter firmly straight in as far as it will go, with the open side of the finger-hole down.

2. Fuse Replacement

The fuse holder is located below the power switch on the back panel of the instrument (see figure 3). Switch the power switch to the *off* (**O**) position and disconnect the power cord. Use a small flat-blade screwdriver or similar tool to pry out the fuse holder. Visually check for a blown fuse. Use a continuity checker, ohmmeter or replacement fuse to check continuity if there is any doubt. Replace, as necessary, with 5 x 20mm time delay (type T) fuses of the proper value. For 100-130V operation, use 2-Amp fuses; for 200-250V operation use 1-Amp fuses.

Re-install the fuse holder into the back of the instrument with the correct arrowhead on the fuseholder matching the arrowhead on the fuseholder socket. If the AC voltage of the power outlet intended for the instrument is within the 100-130V range, the matching arrowheads should indicate 110-120V; if the power outlet AC voltage is within the 200-250V range, the matching arrowheads should indicate 220-240V.

If you intend to connect the instrument to a new or different power outlet, you should first have the outlet ground checked as instructed in Chapter 1, Section A.2 before re-connecting the instrument power cord.

Re-connect the power cord and switch the power switch to the *on* (**I**) position. The instrument should follow the power-up sequence described in Chapter 1, Section D.

NOTE A sample tube should always be kept in the freezing chamber (figure 4, item 9) to exclude extraneous material.

3. Sample Probe Checks and Replacement

Glass-tipped probes are very sensitive and quick to respond, but are somewhat susceptible to pushing, pulling and bumping damage. Such damage often causes varying electrical leakage to ground through the sample and may usually be detected via close visual inspection or disconnecting the connector and checking the probe resistance. This can be done in place without disturbing the physical adjustment of the probe.

The following procedure is recommended for testing and/or replacing the sample probe:

a. Place an empty sample tube in the freezing chamber (figure 4, item 9) to catch any extraneous material that might fall in.

b. Unplug the instrument, it is not sufficient to just turn it off.

c. Remove the head cover by removing the two top screws and pulling the cover straight up.

d. Unplug the sample probe connector (figure 5, item 10). The probe leads are electrically accessible through the side slots in

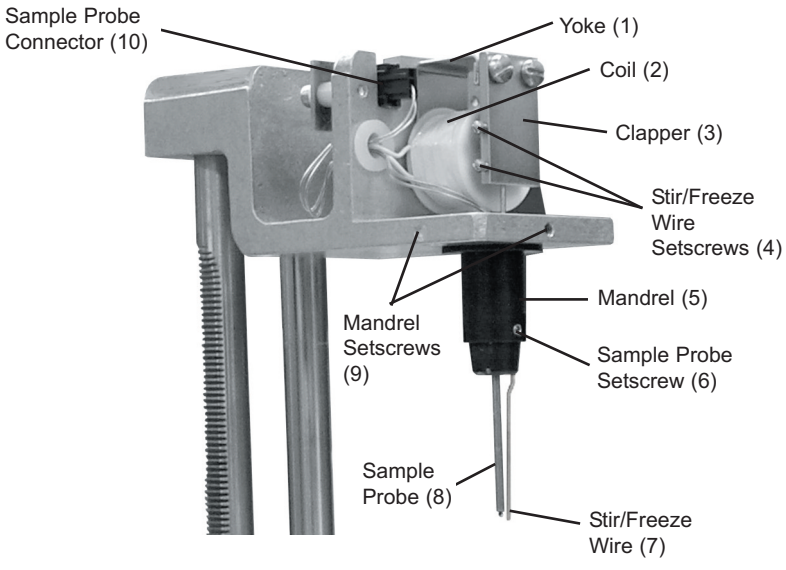

Figure 5: Operating Head

the connector. Use care not to touch or bend the connector pins. Soil or salt from your fingers can increase the electrical resistance of the connection.

e. With the probe at 25ºC room temperature, the resistance between the probe leads should be 2000 ohms ±5% and should be quite sensitive to the warmth of your hand or breath.

   With the tip of the probe immersed in a concentrated NaCl solution (*do not wet the probe leads or connector in salt water*), the resistance between either probe lead and the solution should be greater than 20 megohms. Probe damage is indicated by any deviation from the resistance parameters given above.

If sample probe replacement is indicated:

f. Loosen the two mandrel setscrews (figure 5, item 9). Lower the probe and mandrel down over the stir wire.

g. Fit a new sample probe by pushing the probe connector and wires up through the hole in the head chassis before seating the mandrel. Then raise the mandrel up around the stir wire. Align the mandrel so the stir-wire channel is perpendicular to the front edge of the chassis and so the flange is flush, with no gaps between the flange and the underside of the chassis. Re-tighten the two setscrews to hold the mandrel in place. *Do not over-tighten, overtightening will damage the mandrel*.

h. The probe length is factory set and should not require further adjustment. Proper positioning of the probe and stir wire can be quickly confirmed with the probe and stir-wire alignment tool provided with the instrument, or the method described in section 4.

i. Reconnect the probe connector on the head chassis, taking care once again not to touch or bend the connecting pins.

j. Arrange the leads so that they will not touch the clapper (figure 5, item 3) or be pinched when the head cover is replaced.

k. Replace the head cover and its two attaching screws.

l. Re-connect the power cord and turn the instrument on.

m. Make sure the Supervisor/Operator keyswitch is in the **Supervisor** position (see figure 3 and Chapter 2, Section A.2) for the following steps.

n. When the operating head rises and "**Press START to Continue**" begins to scroll across the display, press the **START** switchpad.

o. When the display changes to "**Osmometer Ready**", press the **TEST** switchpad. The display will change to "**Select Test Item**".

p. At "**Select Test Item**", repeatedly press the > switchpad until the display reads "**Probe Bin Test**".

q. At "**Probe Bin Test**", press **START**. The display will change to "**[Start] Ready?**".

r. At "**[Start] Ready?**", remove the empty sample tube from the freezing chamber, pipette or measure a sample of probe bin-setting fluid into a clean sample tube, place the tube in the freezing chamber and press the **START** switchpad. The 3D3 will run a special freezing-point test to determine the sample probe resistance and bin number.

NOTE In emergency, H_2O may be used in place of bin-setting fluid for this test. The bin number thus determined will be acceptable for bin setting though the probe resistance displayed is that at the freezing point of the H_2O sample used, and will be different from that for bin-setting fluid.

s. Record the sample probe resistance and bin number in the service log in the back of the user's guide; then press the **STOP** switchpad. The display will change to "**Probe Bin Test**".

t. Press **SETUP** to enter the SETUP menu, then repeatedly press the > switchpad until the display reads "**Set Sample Bin #**".

u. At "**Set Sample Bin #**", press the **START** switchpad. The display will report the current sample bin number setting.

v. If the current sample bin number setting is not the same as that just determined, enter the correct bin number by means of the numeric keypad; then press the **ENTER** switchpad. The display

will change to "**Set Sample Bin #**"; then press the **STOP** switchpad to return to "**Osmometer Ready**". If the current sample probe bin setting *is* the same as that just determined, simply press the **STOP** switchpad twice to return to "**Osmometer Ready**".

w. Press the **CALIB** switchpad and calibrate the instrument as instructed in Chapter 4. Re-calibration is required each time the sample probe is replaced.

4. Mandrel, probe and stir/freeze wire alignment

Proper alignment and adjustment of the mandrel, probe and stir/freeze wire are of utmost importance to assure accuracy, precision and proper operation of the instrument.

To facilitate positioning the probe and stir/freeze wire, a probe alignment tool is included with the instrument and with each replacement sample probe, along with instructions for its use.

Alternatively, you can cut a used sample tube in half vertically and use one of the halves to visually align the probe and stir/freeze wire using the following procedure:

a. Hold one of the tube halves up on the mandrel in the position shown in figure 6. Rotate the tube half axially around the mandrel, noting in which direction the tip of the probe must be moved (if any) to perfectly center its black sensor bead in the center of curvature of the bottom of the tube as shown in figure 6. Remove the sample tube.

b. If vertical adjustment of the probe tip is necessary, to center the black bead in the 0.2-mL sample volume, loosen the probe setscrew (figure 5, item 6), then manually raise or lower the probe within the mandrel. Retighten the setscrew gently (overtightening will crack or distort the thin plastic wall of the mandrel). Recheck as described in step "a" above.

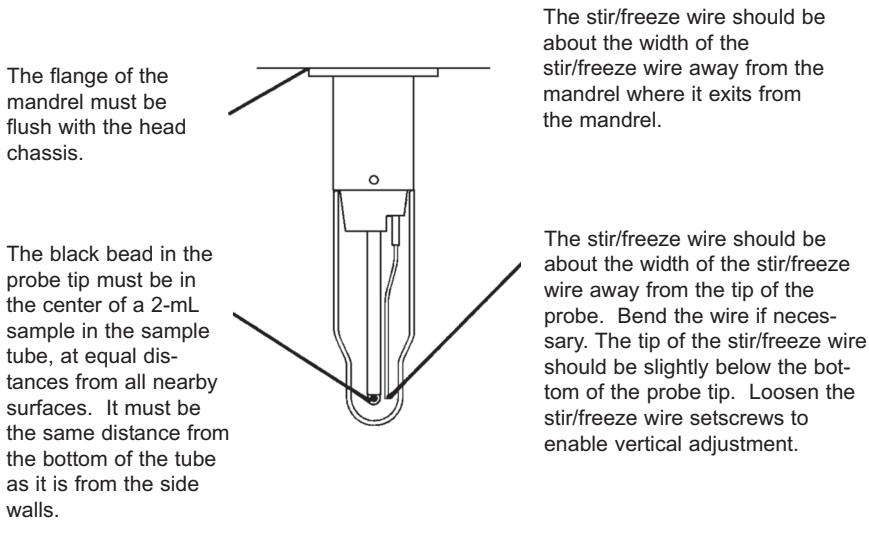
The flange of the mandrel must be flush with the head chassis.
The black bead in the probe tip must be in the center of a 2-mL sample in the sample tube, at equal distances from all nearby surfaces. It must be the same distance from the bottom of the tube as it is from the side walls.
The stir/freeze wire should be about the width of the stir/freeze wire away from the mandrel where it exits from the mandrel.
The stir/freeze wire should be about the width of the stir/freeze wire away from the tip of the probe. Bend the wire if necessary. The tip of the stir/freeze wire should be slightly below the bottom of the probe tip. Loosen the stir/freeze wire setscrews to enable vertical adjustment.

Figure 6: Mandrel, Probe and Stir/Freeze Wire Adjustment

c. If horizontal adjustment is necessary, to center the black bead in the sample volume, bend the metal probe stem gently in the required direction by hand. Recheck as described in step "a" above.

d. Check and adjust the stir/freeze wire position according to the recommendations in figure 6.

5. Stir/freeze amplitude adjustment

The stir and freeze vibration amplitudes are affected by the probe, stir/freeze wire and mandrel positions. If the one-second freeze pulse is not strong enough to freeze samples reliably, first realign the stir/freeze wire according to the recommendations in Chapter 5, Section G.4 and figure 6. Then visually check the freeze and stir vibration amplitudes as follows:

a. Make sure the Supervisor/Operator keyswitch is in the **Supervisor** position while using the TEST and SETUP menus (see figure 3 and Chapter 2, Section A.2).

b. Press the **TEST** switchpad. If the Supervisor/Operator keyswitch is in the **Supervisor** position, the display will change to "Select Test Item".

c. At "Select Test Item", press the **START** switchpad. The display will change to "Test **Menu #: 0**".

d. At "**Test Menu #: 0**", press the **4** switchpad; then press **ENTER**. The display will change to "**Stir/Freeze Test**".

e. At "**Stir/Freeze Test**", press the **START** switchpad. The display will change to "**[stir] [freeze]**".

f. At "**[stir] [freeze]**", a freeze pulse will occur each time the > switchpad is pressed. Watch the tip of the stir/freeze wire and press **>.** The freeze-pulse vibration should produce a loud "buzz". If properly adjusted as recommended in figure 6, the stir/freeze wire should vibrate principally fore and aft and should never strike the probe.

   Look from the side of the instrument as you press > again; the freeze-pulse vibration blur at the very tip of the stir/freeze wire should span at least 0-1/64" or 0-0.5 mm for one second, then cease.

If the freeze vibration is not enough, first remove the head cover by removing the top screws and pulling straight up and make sure that there are absolutely no metal chips between the clapper and the coil armature. Even a single iron chip will greatly reduce the freeze amplitude and must be carefully wiped out of the magnetic gap. Then re-adjust the stir/freeze amplitude as instructed in section 5.

If the freeze vibration is still not enough, readjust the clapper spacing as follows:

g. Refer to figure 5. Bend the yoke (figure 5, item 1) to locate the clapper (item 3) closer to or further away from the coil (item 2), whichever is found to increase the stir/freeze wire tip vibration.

   Changing the coil-to-clapper spacing probably will adversely affect the stir/freeze wire tip location; after bending the yoke, realign the stir/freeze wire according to the recommendations in figure 6.

   Check the freeze vibration amplitudes as instructed in section 5.a-e. Optimum spacing between the coil and clapper should provide at least 0-1/64" or 0-0.5 mm of tip vibration.

   Re-install the operating head cover. Do one last freeze test with the operating head cover re-installed; the freeze pulse characteristics are slightly different with it in place.

If the freeze vibration is still not enough, do not proceed further without obtaining Hot-Line service as recommended in Chapter 5, Section B. If you succeed in obtaining enough freeze vibration, the stir vibration amplitude must be re-adjusted as follows:

h. Check the stir/freeze wire position according to the recommendations in figure 6. If necessary, remove the two top screws, remove the head cover and re-adjust the stir/freeze wire position according to the recommendations in figure 6. Re-install the head cover.

i. Press the **SETUP** switchpad.

j. At "**Select Setup Item**", press the **START** switchpad. The display will change to "**Setup Menu #: 0**".

k. At "**Setup Menu #: 0**", press the **2** switchpad, then press **ENTER**. The display will change to "**Set Stir Amplitude**".

l. At "**Set Stir Amplitude**", press the **START** switchpad. The display will change to "**Amplitude = xx**", with "**xx**" being some two- or three-digit number around 98.

m. Looking from the side of the instrument, you should be able to see a stir vibration blur at the tip of the stir/freeze wire. For 0.2-mL to 0.25-mL osmometer operation, the stir vibration blur at the very tip of the stir/freeze wire should be 0-1/64" or 0-0.5 mm. A very small amount of stirring is necessary to minimize temperature gradients in viscous samples but more than 1/64" or 0.5 mm can cause poor repeatability or frothing which may make it impossible to reliably determine the freezing point.

   If the stir vibration amplitude is not correct, press > to increase the stir amplitude and the "**xx**" value or press < to decrease the stir amplitude and the "**xx**" value. Continue to increase or decrease the "**xx**" value as necessary, until the stir vibration blur at the very tip of the stir/freeze wire is between 0 and 1/64" or between 0 and 0.5 mm.

   As this adjustment is completed, you may wish to hold a sample tube containing a 0.2-mL sample of either an NaCl standard or H_2O up in position on the probe and stir/freeze wire to make sure that froth is not produced.

n. When the stir amplitude is correct, you may wish to record the stir-amplitude "**xx**" value in the Service Log in the back of the user's guide for reference. Press **ENTER** to store the new setting. The display will change to "**Set Stir Amplitude**".

o. At "**Set Stir Amplitude**", press the **STOP** switchpad to exit the SETUP program (or > or < to step to another SETUP item).

p. When **STOP** is pressed, the display will change to "**Osmometer Ready**" and the 3D3 is ready for freezing-point tests.

Notes:

Appendix A
Troubleshooting Table

Symptom	Check	Suggested Action
Abrupt loss of power (no display)	1. Power availability. Temporarily unplug the power cord from its wall outlet and replace it with a known workable lamp or small appliance.	a. Have the power restored.
	2. Power connection.	b. Make sure the power cord is firmly plugged into both the wall outlet and the socket on the back of the instrument.
	3. Measure the AC voltage supplied at the power outlet used for this instrument (see Chapter 1, Section A.2). Compare the measured voltage with the nominal voltage indicated beside the two matching arrowheads on the voltage selector/fuse holder (see figure 3).	

Symptom	Check	Suggested Action
Abrupt loss of power (no display) (continued)	4. Unplug the power cord from the power cord socket. Use a small screwdriver to pry out the voltage selector/fuse holder. Visually check the two 5mm x 20mm time delay (T) fuses mounted in it. Use a continuity checker, ohmmeter, or replacement fuse to check continuity if there is any doubt. Check the values marked on the fuses. For 100-130V operation they should be 2-Amp fuses; for 200-250V operation they should be 1-Amp fuses.	c. Replace the fuses if blown or of incorrect value. d. Re-install the fuse holder into the back of the instrument with the correct arrowheads matching. e. If the fuses were blown and the replacement fuses blow also, see Chapter 5, Section B for further assistance.
"Block Probe Failure"	1. Switch the instrument off, then on. 2. Check the block probe by running the A/D Test (see Chapter 5, Section F.1).	a. If the error message does not persist and other error messages are not displayed, ignore this message. b. If the error message persists, see Chapter 5, Section B for further assistance.
"Calibration Out of Range; Repeat Calib"	Procedure, technique (poor repeatability; see Chapter 2, Section G and Repeatability Tips).	Recalibrate (see Chapter 4).

Symptom	Check	Suggested Action
"Cooling System Error"	1. Switch the instrument off, then on. 2. Check that heat transfer fluid is present in the freezing chamber.	a. Retry the test. b. Make sure the heat transfer fluid is properly installed and primed (see Chapter 1, Sections C and D.4). c. If the error message persists, see Chapter 5, Section B for further assistance.
"EPROM Failure"	Switch the instrument off, then on.	If the error message persists, see Chapter 5, Section B for further assistance.
"Event Record Lost"	Switch the instrument off, then on.	If the error message persists, see Chapter 5, Section B for further assistance.
"Fan Driver Failure"	Switch the instrument off, then on.	a. Retry the test. b. If the error message persists, see Chapter 5, Section B for further assistance.
"Head Not Up" or "Head Not Down"	1. Switch the instrument off, then on. 2. Check the alignment by running the Head Up/Down Test (see Chapter 5, Section F.8).	a. If the error message persists, see Chapter 5, Section B for further assistance.

Symptom	Check	Suggested Action
"Illegal Error Code"	Switch the instrument off, then on.	a. Retry the test. b. If the error message persists, see Chapter 5, Section B for further assistance.
"No Plateau, Repeat Test"		a. Prepare another sample and repeat the test (see Chapter 2, Section G and Repeatability Tips). b. If the error message persists, see Chapter 5, Section B for further assistance.
No response when the START or TEST switchpad is pressed	Switch the instrument off, then on.	If the problem persists, see Chapter 5, Section B for further assistance.
"Parameter RAM Failed" or "New Software Version"		a. If followed by "Reset Probe Configuration," see Symptom item "'Reset Probe Configuration' displayed during the power-up sequence". b. If not followed by "Select Test Item", see Chapter 5, Section B for further assistance.

Symptom	Check	Suggested Action
"RAM Failure"	Switch the instrument off, then on.	If the error message persists, see Chapter 5, Section B for further assistance.
"Re-calibration Needed"	Calibrate the instrument (see Chapter 4).	If the error message repeats after successful recalibration, see Chapter 5, Section B for further assistance.
"Reset Probe Configuration" displayed during the power-up sequence		a. If followed by "Reset Probe Configuration", see Symptom item "Select Test Item". b. If not followed by "Select Test Item", see Chapter 5, Section B for further assistance.
Results not repeatable (too scattered)	1. Operator procedures and technique. 2. Check the sample probe by running the A/D Test (Chapter 5, Section F.1).	a. See Chapter 2, Section G and Repeatability Tips. b. Replace the sample probe (see Chapter 5, Section G.3). c. If the error message persists, see Chapter 5, Section B for further assistance.

Symptom	Check	Suggested Action
"Sample Did Not Freeze, Repeat Test"	**Freeze "buzz" occurred**	**Freeze "buzz" occurred**
	1. Was the sample tube left empty?	a. Prepare another sample and repeat the test (see Chapter 2, Section G and Repeatability Tips).
	2. Is the freezing point of the sample beyond the range of the instrument (see Appendix B)?	b. Try testing samples known to be within the range of the instrument.
	3. Does the sample contain many small bubbles or froth?	c. Make sure the samples contain no bubbles or froth before testing.
		d. Decrease the sample stir amplitude, if necessary, to avoid generating bubbles before the freeze buzz occurs (see Chapter 5, Section G.5).
	4. Is the sample very viscous?	e. The 3D3 is not designed to test thick or very viscous samples.
	5. Is the probe configuration correct?	f. Check/correct the probe bin #'s (see Chapter 2, Section G and Repeatability Tips).

Symptom	Check	Suggested Action
"Sample Did Not Freeze, Repeat Test" (continued)	**Poor or no freeze "buzz"** 1. Check for debris in the magnetic gap between the clapper and coil (see figure 5). 2. The stir/freeze wire must be firmly held in the clapper by both mounting screws (see figure 5). 3. Check the stir/freeze wire alignment (see figure 6). 4. Check the stir/freeze amplitude (see Chapter 5, Section G.5). 5. The stir wire may be fatigued (too ductile).	**Poor or no freeze "buzz"** a. Prepare another sample and repeat the test (see Chapter 2, Section G and Repeatability Tips). b. Clean all debris from the magnetic gap. c. Tighten both stir/freeze mounting screws firmly (see figure 5). d. Correct the stir/freeze wire alignment as necessary (see figure 6). e. Replace, align and adjust the stir/freeze wire (see Chapter 5, Sections G.4 and G.5 and figure 6). f. If the error message persists, see Chapter 5, Section B for further assistance.

Symptom	Check	Suggested Action
"Sample Freeze Error; Repeat Test"	1. Was the sample volume correct? 2. Is the block probe bin # correct? 3. Check the alignment by running the Head Up/Down Test (Chapter 5, Section F.8).	a. Prepare another sample and repeat the test (see Chapter 2, Section G and Repeatability Tips). b. Check/correct the block probe bin # (see Chapter 5, Section F.3). c. If the error message persists, see Chapter 5, Section B for further assistance.
"Result = 0, Calibration Okay?"	Check the calibration (unless running a 0 mOsm sample).	Recalibrate (see Chapter 4) unless running a 0 mOsm sample.
"Sample Probe Failure"	1. Switch the instrument off, then on. 2. Check the sample probe by running the A/D Test (see Chapter 5, Section F.1).	a. If the error message does not persist and other error messages are not displayed, ignore this message. b. Replace the sample probe (see Chapter 5, Section G.3).

Symptom	Check	Suggested Action
"Sample Pre-Freeze; Repeat Test"	1. Were the sample probe and tube clean?	a. Prepare another sample and repeat the test (see Chapter 2, Section G and Repeatability Tips).
	2. Is the probe configuration correct?	b. Check/correct the block probe bin # (see Chapter 5, Section F.3).
	3. Check the stir/freeze wire alignment and adjustment (see Chapter 5, Sections G.4 and G.5 and figure 6).	c. Correct the stir/freeze wire alignment and adjustment as necessary (see Chapter 5, Sections G.4 and G.5 and figure 6).
	4. Particulate matter tends to cause premature crystallization.	d. Try to minimize the effects of materials that tend to cause premature crystallization.
		e. If the error message persists, see Chapter 5, Section B for further assistance.
"Standards Reversed? Repeat Calib"	Did you introduce the right calibration standards in the right order?	Recalibrate with the correct calibration standards (see Chapter 4).
"Stir/Freeze Failure"	Switch the instrument off, then on.	a. Retry the test. b. If the error message persists, see Chapter 5, Section B for further assistance.

Symptom	Check	Suggested Action
"Select Test Item"		a. Press > to advance to "Set Block Probe Bin #" in the SETUP menu and reset the block probe bin # (see Chapter 2, Section C.1). b. Press > to advance to "Set Sample Probe Bin #" in the SETUP menu and reset the sample probe in # (see Chapter 2, Section C.2). c. Reset the stir amplitude, as necessary, to the number recorded in the service log in the back of the user's guide.
"Supervisor Key Needed; Press STOP"	Check the KEYSWITCH position.	Place the KEYSWITCH in the SUPERVISOR position before attempting to use CALIB or TEST.
"Thermo-electrics Driver Failure"	Switch the instrument off, then on.	a. Retry the test. b. If the error message persists, see Chapter 5, Section B for further assistance.

Symptom	Check	Suggested Action
"System Error: Requests" "System Error: Primitive" "System Error: Intercept" "System Error: Communications" "System Error: Unknown" "System Error: Trap" System Error: NMI"	Switch the instrument off, then on.	If the error message persists, see Chapter 5, Section B for further assistance.
"Sample Probe Open?"	1. Switch the instrument off, then on. 2. Check the sample probe by running the A/D Test (see Chapter 5, Section F.1).	a. If the error message does not persist and other error messages are not displayed, ignore this message. b. Replace the sample probe (see Chapter 5, Section G.3).

Symptom	Check	Suggested Action
"Test Time-out Error"	1. Was the sample OK?	a. Prepare another sample and repeat the test (see Chapter 2, Section G and Repeatability Tips).
	2. Does the freezing chamber contain heat transfer fluid?	b. Check the heat transfer fluid (see Chapter 2, Section B). Replace and prime as necessary (see Chapter 1, Section C).
	3. Is the block probe bin # correct?	c. Check/correct the block probe bin # (see Chapter 5, Section F.3).
	4. Check the alignment by running the Head Up/Down Test (see Chapter 5, Section F.8).	d. If the error message persists, see Chapter 5, Section B for further assistance.

Appendix B
Product Specifications

Electrical:	
Power Requirement:	100 to 130 VAC (60 Hz) or 200 to 250 VAC (50 Hz)
Fuses (2):	250V time delay (Type T): 2-Amp (100-130 VAC), 1-Amp (200-250 VAC)
Power Consumption:	150 Watts
Memory Backup:	Integral lithium cell; 10 years typical
Sample Volume:	0.20 to 0.25 mL
Sample Capacity:	Single sample
Readout:	20-character digital display
Units:	mOsm/kg H_2O
Range:	
Low:	0 to 2000 mOsm/kg H_2O
High:	1400 to 4000 mOsm/kg H_2O
Linearity:	Less than ±0.5% from straight line
Resolution:	1 mOsm/kg H_2O
Repeatability:	0 to 400 mOsm ±2 mOsm/kg (1 S.D.) 400 to 4000 mOsm ±0.5% (1 S.D.)
Communications:	DTE RS-232C, parallel printer, barcode
Storage Temperature:	-40 to +45°C (-40 to +113°F)
Operating Temp. (ambient):	18 to 35°C (64 to 95°F)

Drift:	Less than 1 digit per month
Ambient Temperature Effect:	1 digit for every 5°C (9°F) ambient temperature change
Room Humidity:	5 to 80% R.H. (non-condensing)
Startup Time:	From Stand-By: immediately From Power On: under 5 minutes .
Test Time:	Approximately 2 minutes per sample in 0 to 2000 mOsm range; moderately longer in high range.
Dimensions:	inches centimeters
Width:	12.5 32
Depth:	16.5 42
Height:	11.5 29
With Head Up:	16 41
Weight:	pounds kilograms
Net:	27 12
Shipping:	38 18
Warranty:	One-year limited warranty on workmanship and all parts except glass, plastic, and parts warranted by their makers.
Certification:	Intertek 98214

Appendix C
Regulatory Notices

- This product has been designed and manufactured in accordance with U.S., Canadian, and European regulatory requirements as outlined below. Modifications made to this product that are not expressly approved in writing by the manufacturer will void the user's authority to operate this product, previously issued factory approvals, and the user's rights under the warranty.
- The distributor or dealer may have applied additional local, national, or international approvals to this product. Consult the distributor or dealer for more information and documentation.
- Connections to this product must be made with shielded cables. Use of non-shielded cables may violate RFI/EMI limits.

Symbol Conventions

CE This symbol indicates conformity to relevant European directives.

C ETL US LISTED Intertek 98214 This symbol indicates the product was tested to conform to relevant Canadian and U.S. safety standards by Intertek Testing Services NA, Inc. The ETL mark is approved in the United States as a Nationally Recognized Testing Lab (NRTL) by OSHA, and in Canada by the Standards Council of Canada.

Regulatory approval type	Description
U.S. Safety	This product has been listed by ETL testing laboratories as being in compliance with the requirements of UL 3101-1, 1st Edition, "Electrical Equipment for Laboratory Use; Part 1: General Requirements". The "US" in the lower right of the ETL mark demonstrates this listing.
Canadian Safety	This product has been listed by ETL testing laboratories as being in compliance with the requirements of CAN/CSA C22.2 No.1010.1-92, "Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use; General Requirements"; Including Amendment Two. The "C" in the lower left of the ETL mark demonstrates this listing.
EC Declaration of Conformity - EMC	This product meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated using the following standards, as listed in the Official Journal of the European Communities: Consult the Declaration of Conformance certificate shipped with the product for the latest update. • EN 61326: 1998, Group 1, Class B, "Electrical Equipment for Measurement, Control, and Laboratory Use".
EC Declaration of: Conformity - Low Voltage	This product meets the intent of Directive 73/23/EEC, the Low Voltage Directive. Compliance was demonstrated using the following standards as listed in the Official Journal of the European Communities: Consult the Declaration of Conformance certificate shipped with the product (if required) for the latest update. • EN 61010-1 (1993), "Safety Requirements for Electrical Equipment for Measurement,Control and Laboratory Use - General Requirements"; Including Amendment Two (1995).

Appendix D

Warranty & Warranty Duties

LIMITED
WARRANTY
CONDITIONS

MODEL NUMBER: _____
SERIAL NUMBER: _____
INSTALLATION DATE: _____

Advanced Instruments warrants that for 12 months from date of shipment, each new product sold or manufactured is free from defects in material and workmanship under normal installation, use and service except glass, plastic and parts warranted by their makers.

Advanced Instruments agrees that such defects will be remedied or new parts furnished in exchange for any defective part delivered by the owner, transportation charges prepaid, to the factory for our examination. If, in our judgment, the part contains any such defect it will be replaced, charging only for transportation.

This warranty does not extend to any instrument subjected to negligence, accident, abuse, misuse or other improper operation, or which has been tampered with, altered or repaired by anyone other than Advanced Instruments or its authorized service representatives. Nor does this warranty extend to any consequential damages caused by defects or improper use, or secondary damage resulting from prior problems.

The above provisions do not extend the original warranty period of any instrument or part thereof which has been replaced or repaired thereunder.

Remedies made under the terms of this warranty in no case include any obligation or responsibility for transportation charges or arrangements.

All results, calibrations, effectiveness, medical diagnoses and interpretations are the responsibility of the user.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, REPRESENTATIONS AND CONDITIONS OF ANY KIND, EXPRESSED OR IMPLIED IN FACT OR BY LAW. IN NO EVENT SHALL ADVANCED INSTRUMENTS BE LIABLE UNDER THIS WARRANTY OR OTHERWISE IN ANY MATTER FOR ANY REMOTE OR CONSEQUENTIAL DAMAGES RESULTING FROM THE BREACH OF THIS WARRANTY OR CONDITION IMPLIED BY LAW OR OTHERWISE, OR FOR ANY DAMAGE TO THE INSTRUMENT OR ANY PART THEREOF CAUSED BY IMPROPER INSTALLATION, UNAUTHORIZED REPAIR OR ALTERATION, NEGLIGENCE, ABUSE OR MISUSE INCLUDING USE OF IMPROPER GLASSWARE OR REAGENTS, ACCIDENT, OR ACT OF GOD.

Attention is called to the user's responsibility regarding reasonable use, useful life of the instrument and immediate notification of accident outlined in the warranty duties section of the user's guide and/or service manual.

No person is authorized to assume for us any other liability in connection with the sale or service of this equipment.

Advanced Instruments reserves the right, at any time without notice, to make changes in price, color, material, specifications and models without incurring liability to modify products previously produced, and to add or discontinue models and accessories.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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By accepting and operating this instrument, the user and Advanced Instruments agree to the following responsibilities which constitute contractual warranties and conditions between the seller and the user for the maximum benefit and usefulness of the instrument.

ADVANCED INSTRUMENTS WARRANTS THAT IT:

1. Has produced equipment equal to or exceeding that of any competitive product in the same price range in standards of design, material and workmanship.

2. Knows of no defects in design or materials which may cause bodily injury.
3. Will endeavor to advise the user of changes or improvements in the instrument as they are developed, so that the user may take steps to improve the safety and performance of his equipment throughout its useful life.
4. Will replace or repair equipment according to the guarantee on the attached warranty.
5. Will cooperate closely in common defense of any accident involving this equipment, or third-party suit against the user or operating personnel, if advised immediately by the user of the occurrence of any accident.

THE USER WARRANTS THAT:

1. The instrument will be used reasonably.
2. The instrument will be regularly maintained according to this manual, including a log of all service, tests and repairs performed on the equipment, and records will be kept of all requests for repair made to Advanced Instruments where such repairs were beyond the ability of local service personnel.
3. The instrument will not be altered without written approval from Advanced Instruments.
4. Advanced Instruments will be notified immediately if any injury occurs in any association with the instrument and will be allowed prompt and thorough examination of the instrument in question.
5. Advanced Instruments will be held harmless in cases of injury arising (see definitions below):
    a. Beyond the useful life of the equipment.
    b. From unreasonable use.
    c. When Advanced Instruments is not immediately notified of said injury.
    d. From interpretation of results.

DEFINITIONS

1. "Useful life" is:
    a. The same as the depreciation life in the Internal Revenue Service guidelines, whether or not the user actually depreciates the instrument, but not to exceed 10 years from date of delivery to the user.
    b. Only during the time the equipment has been maintained on a regular basis as prescribed by Advanced Instruments. If the user is in an area which has no local service, Advanced Instruments may require a local service person (understood to mean the person actually performing the "hands-on" service of the equipment) to attend and pass a reasonable maintenance and repair course.
    c. Only during the time when the user has not altered the equipment in any way without written approval from Advanced Instruments.

d. Only during the time when the user has not loaned, leased or resold the equipment to any third party.

2. "Reasonable use" is use:

a. According to the instructions supplied by Advanced Instruments (assuming English-reading personnel or supervision). If neither the supervisor nor the operator reads English, the user agrees to obtain accurate translations of the instrument labels, instructions, user's guides and/or manuals provided.

b. Under direct, on-the-job supervision of the supervisor or other professional in charge.

c. In which there are no known defects or uncorrected repairs.

d. Only for the purpose stated in the instructions provided with the instrument.

e. In which the equipment has been maintained according to the instructions provided.

3. "Immediate notification" is:

a. Recognition that time is of the essence when any accident, malpractice or product liability arises which involves Advanced Instruments equipment.

b. Notification to Advanced Instruments immediately (the same day, if possible) in the event of injury to any person in circumstances involving Advanced Instruments equipment in which Advanced Instruments might be named as a defendant in any form of litigation.

c. Allowing Advanced Instruments or its representatives, immediate, full, and thorough examination of Advanced Instruments equipment, and all records pertaining to such equipment.

Notes:

Appendix E

Supplemental RS-232 Information

The DB-9 RS-232 port on your instrument conforms to the DTE EIA-232 standard and can reliably communicate over shielded cable up to 10 meters in length, depending on the baudrate you use. Almost every item of information displayed by your instrument is also transmitted over the RS-232 port, including test results, all error messages, and most display data from the diagnostic menu.

Data is transmitted asynchronously as 1 start bit, 8 data bits and 1 stop bit, with no parity. Each message transmitted from the communication port is terminated by the sequence, Carriage Return (0D Hex), Line Feed (0A Hex). Note that your instrument is only capable of outputting information. At this time, there is no protocol for talking to the instrument.

Sample RS-232 Setup

As a typical example of a communications program setup, the following instructions will describe the process necessary for using your instrument in conjunction with Hyperterminal for Windows® 95 or later operating systems and a null modem cable, available from Advanced Instruments, as shown in the diagram below. You can use this procedure to be sure that your instrument and cable are operating correctly.

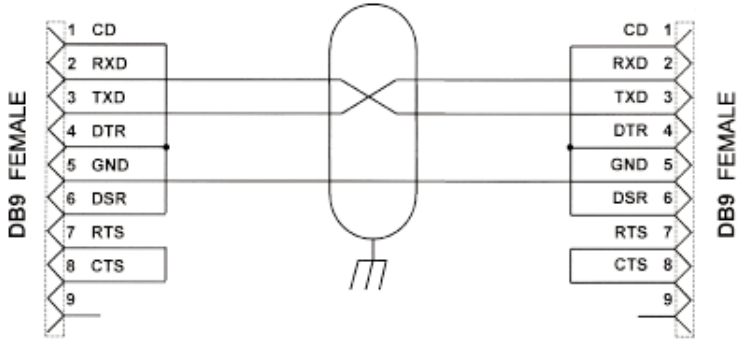
1. Create a Hyperterminal connection using the Hyperterminal program.
2. While working within that connection, choose the Properties selection from the File menu.

3. Select the Configure button.
4. Choose the following settings for the Configure menu and click on the OK button.

Bits per second	See user's guide.
Data bits	8
Parity	None
Stop bits	1
Flow control	None

5. Select the Settings menu.
6. Chose TTY for the Emulation option.
7. Select ASCII setup.
8. Set the Sending option to Echo Typed Characters Locally.
9. Set the Receiving option to Wrap Lines that Exceed Terminal Width.

You should at this point see all instrument output in the Hyperterminal window of your computer screen.



Null Modem Cable

Shield connects to metalized connector housing at both ends.

Figure 7: RS-232 External Cable

Appendix F
Symbol Definitions

	On-Off		Functional Arrow
	Feed		Printer
	Interrupt		Enter
	Test		RS232
	Start		Bar Code
	Stop		Attention
	Record Review		Caution Hot Surface
	Setup		Dangerous Voltage
	Calibration		Lifting Hazard
	Cancel; Delete		Calibrator

CONT	Content		Do Not Open Top
CONTROL	Control	HANDLE WITH CARE	Handle With Care
CONTROL -	Negative Control		Toxic
CONTROL +	Positive Control	USE BLADE TO OPEN	Use Blade To Open
	Flammable		Do Not Re-Use
	Fragile	IVD	For *In Vitro* Diagnostic Use
	Irritant	CE	European Conformity
	Keep Dry		Temperature Limit
	Date Manufactured		See Instructions
STERILE	Sterile	LOT	Lot Number
NON STERILE	Non-Sterile		Use By; Expiration Date
SN	Serial Number	EC REP	Authorized Representative
SOLN	Solution	REF	Part Number

	Sufficient for [x] Tests		Latex-Free
	Open Here		Diluent
	Low Fluid Level		See Instructions for Temperature Guidelines
	Keep Hands Clear		Potential Puncture Hazard

Notes:

Appendix G

Service Log

Model: **3D3**

Serial Number: _____

Software Revision: _____

Sample Probe Number: _____

Block Probe Number: _____

Date	Problem/Symptom	Action

Date	Problem/Symptom	Action

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